# National Marine Fisheries Service
# Endangered Species Act Section 7
# Biological and Conference Opinion

**Title:** Programmatic Biological and Conference Opinion on Construction and Operation of up to Six New Icebreakers to Support Coast Guard Missions in the Arctic and Antarctic

**Consultation Conducted By:** Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce

**Action Agencies:** United States Coast Guard and Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service

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# 1 INTRODUCTION

The Endangered Species Act of 1973 (ESA), as amended (16 USC 1531 et seq.) establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with the National Marine Fisheries Service (NMFS) for those listed threatened or endangered species, or designated critical habitat that may be affected by the action that are under NMFS jurisdiction (50 C.F.R. §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS concurs with that determination for species under NMFS jurisdiction, informal consultation is concluded (50 C.F.R. §402.14(b)).

The Federal action agency shall confer with the NMFS for species under NMFS jurisdiction on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat (50 C.F.R. §402.10). If requested by the Federal agency and deemed appropriate, the conference may be conducted in accordance with the procedures for formal consultation in 50 C.F.R. §402.14.

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS provide an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, NMFS provides a reasonable and prudent alternative that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If incidental take is reasonably expected, section 7(b)(4) requires NMFS to provide an incidental take statement (ITS), which exempts take incidental to an otherwise lawful action, and specifies the impact of any incidental taking, including reasonable and prudent measures (RPMs) to minimize such impacts and terms and conditions to implement the RPMs.

Updates to the regulations governing interagency consultation (50 C.F.R. 402) became effective on October 28, 2019 (84 FR 44976). This consultation was pending at the time the regulations became effective and we are applying the updated regulations to the consultation. As the preamble to the final rule adopting the regulations noted, "[t]his final rule does not lower or raise the bar on section 7 consultations, and it does not alter what is required or analyzed during a consultation. Instead, it improves clarity and consistency, streamlines consultations, and codifies existing practice." We have reviewed the information and analyses relied upon to complete this biological opinion (Opinion) in light of the updated regulations and conclude the Opinion is fully consistent with the updated regulations.

The lead Federal action agency for this consultation is the United States Coast Guard (USCG). The USCG proposes to construct three heavy and three medium icebreakers under its Polar

Security Cutter (PSC) Program. The first of these new icebreakers is expected to be delivered in 2023. The USCG proposes the use of the new icebreakers to conduct operations and training exercises to meet USCG mission responsibilities in the U.S. Arctic and Antarctic regions, in addition to vessel performance testing post-dry dock in the Pacific Northwest near the probable homeport of Seattle, Washington, where the USCG's existing polar icebreaker fleet are homeported. The NMFS Office of Protected Resources Permits and Conservation Division will also be considered an action agency because it will need to issue a rule under the Marine Mammal Protection Act (MMPA) due to USCG’s anticipated harassment of marine mammals and potential for injury or mortality associated with icebreaking activities. The MMPA rule will include marine mammals that are also ESA-listed. For this reason, the Interagency Cooperation Division is coordinating with the Permits and Conservation Division to ensure the findings in this opinion are consistent with MMPA requirements, as well as protective of ESA-listed marine mammals.

Program activities include actions associated with the operation of the new icebreakers once construction of the first vessel commences through the expected 30-year service life of each vessel. The proposed action is projected to cover 40 years because the first vessel is expected to become operational in 2023 and then a new vessel will be constructed every 1.5 years after that if funding is secured. This programmatic consultation consults on activities by the USCG and the MMPA rule-making process by NMFS Permits and Conservation Division for new vessels and their operation.

*Programmatic Consultations*

NMFS and the U.S. Fish and Wildlife Service (USFWS) have developed a range of techniques to streamline the procedures and time involved in consultations for broad agency programs or numerous similar activities with predictable effects on listed species and critical habitat. Some of the more common of these techniques and the requirements for ensuring that streamlined consultation procedures comply with section 7 of the ESA and its implementing regulations are discussed in the October 2002 joint Services memorandum Alternative Approaches for Streamlining Section 7 Consultation on Hazardous Fuels Treatment Projects (see also 68 FR 1628 [January 13, 2003] for the notice of availability of the memorandum).

A programmatic consultation is a consultation addressing an agency’s multiple actions on a program, region, or other basis usually over an extended period of time. Programmatic consultations allow the Services to consult on the effects of programmatic actions such as: (1) multiple similar, frequently occurring or routine actions expected to be implemented in particular geographic areas; and (2) a proposed program, plan, policy, or regulation providing a framework for future proposed actions (84 FR 44976, August 27, 2019). A programmatic consultation should identify project design criteria (PDCs) or standards that will be applicable to all future projects implemented under the program. PDCs serve to prevent adverse effects to listed species, or to limit adverse effects to predictable levels that will not jeopardize the continued existence of listed species or destroy or adversely modify critical habitat. Avoidance and minimization of adverse effects to species and their designated critical habitat is accomplished by implementing PDCs at the individual project level or taken together from all projects under the programmatic consultation. For those activities that meet the PDCs, there is no need for project-specific consultations. For actions that do not meet the PDCs or for which specifics of individual activities are not yet known, step-down consultations are needed under a programmatic consultation. The following elements should be included in a programmatic consultation to ensure its consistency with ESA section 7 and its implementing regulations:

1. Description of the manner in which activities to be implemented under the programmatic consultation may affect listed species and critical habitat and evaluation of expected level of adverse effects from covered projects;

2. PDCs to prevent or limit future adverse effects on listed species and designated critical habitat;

3. Process for evaluating and tracking expected and actual aggregate (net) additive effects of all projects expected to be addressed under the programmatic consultation. The programmatic consultation document must demonstrate that when the PDCs are applied to each project, the aggregate effect of all projects would not jeopardize listed species or destroy or adversely modify critical habitat;

4. Procedures for streamlined step-down consultation. As discussed above, if an approved programmatic consultation document is sufficiently detailed, step-down consultations ideally will consist of certifications, concurrences, or a streamlined opinion between action agency biologists and consulting agency biologists. An action agency biologist or team will provide a description of a proposed project and a certification that it will be implemented in accordance with the PDCs. The action agency also provides a description of anticipated project-specific effects and a tallying of net effects to date resulting from projects implemented under the program, and certification that these effects are consistent with those anticipated in the programmatic consultation. The consulting agency biologist reviews the submission and provides concurrence or an opinion, or offers adjustments to the project necessary to bring it into compliance with the programmatic consultation. The project-specific consultation process must also identify any effects that were not considered in the programmatic consultation and an ITS will be prepared to exempt additional incidental take, if needed, for the step-down, formal consultation. Finally, project-specific consultation procedures must provide contingencies for proposed projects that cannot be implemented in accordance with the PDCs; full stand-alone consultation may be performed on these projects if they are too dissimilar in nature or in expected effects from those projected in the programmatic opinion;

5. Procedures for monitoring projects and validating effects predictions; and

6. Comprehensive review of the program, generally conducted annually.

A framework programmatic action is a federal action that approves a framework for the development of future actions that are authorized, funded, or carried out later. In a step-down tiered approach under the framework programmatic action, which is what will be used here, the programmatic consultation establishes an analytical and standardized framework so that future step-down consultations, if necessary, may occur at the implementation or authorization stage when the effects are better known and thus the consultation will be more effective and efficient. The Services promulgated changes to the section 7(a)(2) implementing regulations (80 FR 26832, May 11, 2015; ITS rule) that defines two types of programmatic actions addressing certain types of policies, plans, regulations, and programs. In this type of programmatic action, any take of ESA-listed species would not occur unless and until those future actions are authorized, funded, or carried out and subject to a separate step-down consultation, as appropriate. At that time, an ITS may be issued, if necessary, to exempt incidental take causes by those specific actions. The second type of programmatic action, known as a mixed programmatic action, such as the Navy's phased investigation and removal/remedial activities within UXO 16, combines direct approval of actions that will not be subject to further ESA section 7(a)(2) consultation and approval of a framework for the development of future actions that are authorized, funded, or carried out at a later time. For mixed programmatic actions, as defined in the 2015 ITS rule at 50 C.F.R. 402.02, NMFS is required to issue an ITS for those portions of the program that are authorized at the program level, not subject to a future section 7 consultation, are reasonably certain to result in incidental take, and are otherwise compliant with ESA section 7(a)(2). In this type of mixed programmatic action, any future actions within the framework that will be subject to step-down consultations when the future actions are authorized, funded, or carried out, an ITS may be issued at that time for the incidental take associated with those actions, as necessary.

This consultation and the resulting biological and conference opinion, and associated ITS were completed in accordance with section 7(a)(2) of the statute (16 USC 1536 (a)(2)), associated implementing regulations (50 C.F.R. §§402.01-402.16), and agency policy and guidance. This consultation was conducted by the NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division (hereafter referred to as "we" or "our"). This biological opinion (Opinion) and ITS were prepared by the NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 C.F.R. Part 402.

This document represents our opinion on the effects of these actions on bocaccio (*Sebastes paucispinis*; Puget Sound Distinct Population Segment [DPS]); chinook (*Oncorhynchus tshawytscha*; Sacramento River Winter-Run, Upper Columbia River Spring-Run, Snake River Spring/Summer-Run, Snake River Fall-Run, Central Valley Spring-Run, California Coast, Puget

Sound, Lower Columbia River, and Upper Willamette River Evolutionary Significant Units [ESUs]), chum (*Oncorhynchus keta*; Hood Summer-Run and Columbia River ESUs), coho (*Oncorhynchus kisutch*; Central California Coast, Southern Oregon/Northern California Coasts, Lower Columbia River, and Oregon Coast ESUs), and sockeye salmon (*Oncorhynchus nerka*; Snake River and Ozette Lake ESUs); Pacific eulachon (*Thaleichthys pacificus*; Southern DPS), and Atlantic (Gulf of Maine DPS) salmon (*Salmo salar*); steelhead trout (*Oncorhynchus mykiss*; Southern California, Upper Columbia River, Snake River Basin, Middle Columbia River, Lower Columbia River, Upper Willamette River, South-Central California Coast, Central California Coast, Northern California, California Central Valley, Puget Sound DPSs); yelloweye rockfish (*Sebastes ruberrimus*; Puget Sound/Georgia Basin DPS); giant manta ray (*Manta birostris*); Nassau grouper (*Epinephelus striatus*); Oceanic whitetip (*Carcharhinus longimanus*) and scalloped hammerhead (*Sphyrna lewini*; Northwest and Western Central Atlantic, Southwest Atlantic, Eastern Atlantic, Indo-West Pacific, Central Pacific, and Eastern Pacific DPSs), and daggernose sharks (*Isogomphodon oxyrhynchus*); blackchin guitarfish (*Rhinobatos cemiculus*); narrow (*Anoxypristis cuspidata*) and smalltooth sawfish (*Pristis pentinata*); Gulf (*Acipenser oxyrinchus desotoi*), shortnose (*Acipenser brevirostrum*), green (*Acipenser medirostris*; Southern DPS), and Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*; Chesapeake Bay DPS and Gulf of Maine DPS); lobed star (*Orbicella annularis*), mountainous star (*Orbicella faveolata*), boulder star (*Orbicella franksi*), elkhorn (*Acropora palmata*), staghorn (*Acropora cervicornis*), pillar (*Dendrogyra cylindrus*), and rough cactus corals (*Mycetophyllia ferox*); ESA-listed Pacific corals: *Acropora globiceps*, *Acropora lokani*, *Acropora retusa*, *Acropora speciosa*, *Euphyllia paradivisa*, *Isopora crateriformis*, *Seriatopora aculeata*, and *Siderastrea glynni*; black (*Haliotis cracherodii*) and white abalone (*Haliotis sorenseni*); leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*; North Atlantic, South Atlantic, East Indian-West Pacific Ocean, Central North Pacific Ocean, Central South Pacific Ocean, East Pacific Ocean, Southwest Indian Ocean, and Southwest Pacific DPSs), Kemp's ridley (*Lepidochelys kempii*), olive ridley (*Lepidochelys olivacea*; Mexico's Pacific coast breeding population and all other populations), and loggerhead (*Caretta caretta*; North Pacific Ocean, South Pacific Ocean, Northwest Atlantic Ocean, Northeast Atlantic, Southwest Indian Ocean, and Southeast Indo-Pacific Ocean DPSs) sea turtles; blue (*Balaenoptera musculus*), bowhead (*Balaena mysticetus*), fin (*Balaenoptera physalus*), gray (*Eschrichtius robustus*; Western North Pacific DPS), humpback (*Megaptera novaeangliae*; Western North Pacific, Central America, and Mexico DPSs), North Pacific right (*Eubalaena glacialis*), North Atlantic right (*Eubalaena japonica*), Southern right (*Eubalaena australis*), false killer (*Pseudorca crassidens*; Main Hawaiian Island Insular DPS), sei (*Balaenoptera borealis*), killer (*Orcinus orca*; Southern Resident DPS), and sperm whales (*Physeter microcephalus*); Steller (Western DPS) sea lion (*Eumetopias jubatus*); and bearded (*Erignathus barbatus*; Beringia DPS), ringed (*Phoca hispida hispida*; Arctic subspecies), Guadalupe fur (*Arctocephalus townsendi*), and Hawaiian monk seals (*Neomonachus schauinslandi*); North Pacific right whale critical habitat; Southern Resident killer whale critical habitat; Steller sea lion critical habitat; Hawaiian monk seal critical habitat;

elkhorn and staghorn coral critical habitat; Green sturgeon Southern DPS critical habitat; and ringed seal Arctic subspecies and humpback whale Mexico and Northwest Pacific DPSs proposed critical habitat.

A complete record of this consultation is on file at the NMFS Office of Protected Resources in Silver Spring, Maryland.

## 1.1 Background

The U.S. has sovereign rights and responsibilities in the Arctic as one of eight nations having territory and citizens in the region, including obligations to the citizens of Alaska, economic interests, a range of international responsibilities and treaty obligations, and other foreign and domestic policy interests (USCG 2017). In Antarctica, the U.S. does not claim sovereignty but maintains a presence in accordance with the Antarctic Treaty (USCG 2017).

There has been a progressive decline in the thickness and extent of sea ice in the Arctic, leading to the creation of a navigation route through the Northwest Passage, an opening in the ice in the Northern Sea Route, and an increase in vessel activity in the Arctic. From 2008 to 2015, traffic through the Bering Strait increased by 145 percent (USCG 2016; cited in USCG 2017). With increased vessel traffic there is increased potential for search and rescue, water pollution, illegal fishing, and infringement on the U.S. Exclusive Economic Zone (EEZ), requiring USCG operations in the Arctic (USCG 2017).

There is no permanent human population on the Antarctic continent, but there is a research presence with entry for most U.S. Antarctic Program cargo and personnel through McMurdo Station at the edge of the Ross Sea, which also serves as a logistics facility for airborne resupply of inland stations and for field science projects, as well as a waste management center (USCG 2017). There is also an increasing number of cruise ship tours to Antarctica. Smaller vessels (less than 500 passengers) are allowed to land, although only 100 people per day are permitted to disembark, and many ships also operate zodiacs (small inflatable, military grade boats) to take passengers on wildlife-watching tours.

The USCG authority for the use of icebreaking comes from several statutes that govern the execution of the USCG's mission including: 14 USC 81 (Coast Guard establishment, maintenance, and operation of aids to navigation), 14 USC 88 (Coast Guard saving of life and property), 14 USC 89 (Coast Guard law enforcement), 14 USC 91 (controlling anchorage and movement of vessels), 14 USC 94 (conduct oceanographic research), and 14 USC 141 (cooperation with agencies, States, territories, and others). Executive Order 7521 (Use of Vessels for Icebreaking in Channels and Harbors) directs the USCG to assist in keeping channels and harbors open to navigation using icebreaking. A Department of Homeland Security Mission Need Statement approved in June 2013 recognized the need for the USCG to expand its icebreaking capacity, potentially requiring a fleet of up to six icebreakers with three heavy and three medium vessels (O'Rourke 2015).

The USCG currently has one heavy icebreaker in service, Coast Guard Cutter (CGC) POLAR STAR. The CGC POLAR STAR was commissioned in 1978, but exceeded its designed 30-year service life. It began reactivation in 2010 and completed a service life extension in 2013 to allow it to operate an additional 7 to 10 years. The USCG has one medium icebreaker in service, CGC HEALY, which will reach the end of its service life in 2030 (USCG 2017). Despite a diminution in polar ice due to climate change, the need for polar icebreakers is not expected to change and may instead increase as there will still be large areas of polar ice and continued and potentially increased demand for support for maritime transport and other interests in the Arctic and Antarctic. For these reasons, the USCG PSC Program has requested the acquisition of three medium and three heavy icebreakers with planned 30-year service lives.

### 1.2 Consultation History

On December 21, 2017, the USCG submitted a request for an informal section 7 consultation to the NMFS Alaska Region by letter dated December 19, 2017. After reviewing the consultation request, the Alaska Region determined that the action area encompassed areas outside the region and requested that the consultation be transferred to the Office of Protected Resources (OPR) in Silver Spring, Maryland on December 21, 2017. The NMFS headquarters office often takes the lead on consultations for actions spanning multiple regions. The consultation was sent to OPR and assigned to a consultation biologist on April 19, 2018.

This Opinion is based on information provided by the USCG, including the *Endangered Species Act Section 7 Informal Consultation: Polar Icebreaker* (USCG 2017) Biological Evaluation (BE) submitted to the Alaska Region by the USCG Headquarters. Our communication with the USCG regarding this consultation is summarized as follows:

- **April 26, 2018:** NMFS OPR notified the USCG via email that we received the consultation request
- **May 1, 2018:** NMFS staff from OPR and Alaska Region participated in a conference call with the USCG Headquarters representatives from the Polar Icebreaker Program (now the PSC Program) and the Office of Environmental Management and Department of the Navy (Navy), Naval Undersea Warfare Center (NUWC) representatives, who provided technical assistance to the USCG to discuss the consultation request. NMFS staff informed USCG that NMFS believed the consultation should be formal, and discussed the request for additional information NMFS sent via email the same day.
- **July 5, 2018:** NMFS received email response from USCG regarding the additional information we requested.
- **July 31, 2018:** NMFS held the first biweekly conference call to discuss the consultation with USCG, NUWC, and representatives from NMFS (OPR, Alaska Region, and West Coast Region) and clarify the USCG response to the previous request for additional information.

- **September 12, 2018:** NMFS sent a letter to the USCG via email requesting additional information and recommending a formal programmatic consultation be conducted for the action.
- **September 18, 2018:** NMFS sent an additional information request via email to the USCG after a new West Coast Region staff member was added to the project team and reviewed the USCG submission to NMFS.
- **October 16, 2018:** NMFS received the USCG's response to our letter and email requests for additional information.
- **October 17, 2018:** NMFS participated in a meeting with USCG, the U.S. Fish and Wildlife Service, and the NUWC to clarify the scope of the action and discuss consultation timelines. NMFS sent an email with some follow up questions to USCG the same day.
- **November 5, 2018:** The USCG sent a response to our October 17, 2018 questions to NMFS via email.
- **November 15, 2018:** NMFS sent an initiation letter to the USCG with initiation date of November 5, 2018.
- **November 16, 2018:** NMFS sent questions to the USCG from the Permits and Conservation Division related to requirements for the protection of marine mammals under the MMPA that are also ESA-listed. The USCG sent its 7(d) determination by letter to NMFS regarding the ESA consultation.
- **November 20, 2018:** NMFS, the USCG, and the NUWC (who assisted with the acoustic effects analysis) held a conference call to further discuss the MMPA comments and the way forward in order to include information regarding the acoustic analysis in the Opinion that is consistent with the NMFS Permits and Conservation Division requirements under the MMPA.
- **December 4, 2018:** NMFS sent an email to the USCG with questions on the action and requested that the USCG clarify portions of the action description and provide any standard operating procedures (SOPs) or best management practices (BMPs) for vessel transit and the Pacific Northwest operations area.
- **December 18, 2018:** The USCG provided responses to NMFS via email regarding the action. NMFS sent an email message the same day acknowledging receipt of the response and noting that, because the USCG response did not include additional SOPs or BMPs, NMFS will include some for vessel operations and transit based on SOPs/BMPs from similar consultations, such as Navy training and testing using vessels.
- **December 20, 2018:** The USCG provided responses to our November 16, 2018, email with questions regarding the acoustic analysis of icebreaker noise. NMFS sent email responses on December 20 and 21, 2018, with specifics regarding our continued concerns with the approach suggested by the USCG for estimating potential effects from icebreaking noise.

- **January 28, 2019:** Consultation was resumed on this day after being held in abeyance for 38 days due to a lapse in appropriations that resulted in a partial government shutdown.
- **January 29, 2019:** NMFS and the USCG had a conference call regarding the consultation and NMFS sent an email detailing the information we requested from the USCG prior to the government shutdown that was still pending. The USCG provided a response to our additional comments regarding the acoustic analyses used for icebreaker noise.
- **February 6, 2019:** NMFS sent an email to the USCG with additional questions raised by our regions after reviewing the first sections of the draft Opinion regarding the action details.
- **February 7, 2019:** The USCG sent an email to NMFS with responses to the questions we asked in December 2018. The USCG also sent an email with more details regarding the acoustic analysis provided in the BE and additional modeling conducted in response to requests from the NMFS Permits and Conservation Division
- **February 13, 2019:** The USCG sent a response to some of the questions raised by regional reviewers via email.
- **February 26, 2019:** The USCG sent a response via email to the remaining questions raised by regional reviewers regarding helicopter operation.
- **March 25, 2019:** The draft Opinion was sent to the USCG for review.
- **June 11, 2019:** The USCG sent an email with a marked-up version of the draft Opinion with their comments, and noted that comments on the PDCs would be sent separately.
- **July 10, 2019:** The USCG sent a spreadsheet with comments on the PDCs included in the draft Opinion.
- **July 16, 2019:** The USCG, NUWC, and NMFS participated in a call to discuss next steps, time line, and schedule follow up calls.
- **August 13, 2019:** The USCG, NUWC, and NMFS had a call to begin discussions about NMFS responses to comment on the PDCs.
- **September 3, 2019:** The USCG sent comments regarding our response to their revisions to the PDC language via email.
- **September 5, 2019:** NMFS, USCG, and NUWC had a call to discuss the language of the PDCs and consider additional revisions. NMFS shared a document with the proposed language revisions prior to the call and then a new document that included the additional revisions agreed to during the call with the USCG via email.
- **October 8, 2019:** USCG sent an email to NMFS with suggested language for additional revisions to the PDCs and a note regarding the calculation method they will use to determine the potential area of ice impacted by each icebreaking activity.
- **February 14, 2020:** USCG sent comments on the revised Opinion to NMFS via email.

# 2 THE ASSESSMENT FRAMEWORK

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species; or adversely modify or destroy their designated critical habitat.

*"Jeopardize the continued existence of"* means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 C.F.R. §402.02).

*"Destruction or adverse modification"* means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of an ESA-listed species as a whole (50 C.F.R. §402.02).

This ESA section 7 consultation involves the following steps:

*Description of the Action* (Section 3): In the case of this programmatic consultation, this includes a description of the action on the part of both the USCG and NMFS Permits and Conservation Division, including those activities that will not require further consultation and those activities expected to be implemented in the future for which step-down consultations will be required, if they may affect listed species or designated critical habitat, because the specifics are not known at this time. This section also includes the PDCs for avoidance and minimization of impacts to ESA-listed species and designated critical habitat, and information regarding the procedures for submitting step-down consultation requests and conducting regular reviews under the programmatic consultation.

*Action Area* (Section 4): We describe the action and those aspects (or stressors) of the action that may have effects on the physical, chemical, and biotic environment. We describe the action area with the spatial extent of the stressors from the action. Thus, we evaluate the effects vessel transit routes may have on ESA-listed species and designated critical habitat and so include the approximate footprints of these in this consultation as part of the action area.

*Stressors Associated with the Action* (Section 5): We discuss the potential stressors we expect to result from the action for both the activities that will not require further consultation and for activities that will require step-down consultations.

*Status of Species and Designated Critical Habitat* (Section 6): We identify the ESA-listed species and designated critical habitat that are likely to co-occur with the stressors from the action in space and time and evaluate the status of those species and habitat. We also identify those *Species and Designated Critical Habitat Not Likely to be Adversely Affected* and detail our effects analysis for these species and critical habitats (Section 6.1) and identify the status of the *Species and Designated Critical Habitat Likely to be Adversely Affected* (Section 6.2).

*Environmental Baseline (*Section 7): We describe the environmental baseline as the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

*Effects of the Action* (Section 8): Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. These are broken into a risk analysis and programmatic analysis as described below for the species and/or critical habitat that are likely to be adversely affected by the action. The species and critical habitat included in this section will be subject to future step-down consultations as details of certain activities become known and the USCG provides funding, authorization, and/or prepares to carry out these activities and NMFS Permits and Conservation Division authorize impacts to marine mammals for these activities. We include a section (8.1) for stressors that are not likely to adversely affect those species and critical habitat for which other stressors were determined likely to adversely affect and a section (8.2) for assumptions underlying the estimation of effects in this mixed programmatic consultation.

*Exposure, Response, Risk Analysis* (Section 8.3): In the Risk Analysis, we evaluate the potential adverse effects of the action on ESA-listed species and designated critical habitat under NMFS jurisdiction without consideration of the PDCs. To do this, we begin with problem formulation that identifies and integrates the stressors of the action with the species' status (Section 6) and the Environmental Baseline (Section 7) and formulate risk hypotheses based on the anticipated exposure of listed species and critical habitat to stressors and the likely response of species and habitats to this exposure. Future step-down consultations will identify the number, age (or life stage), and sex of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong as needed. The effects analysis in step-down consultations will also assess the consequences of the responses of individuals of ESA-listed species that are likely to be exposed to the populations those individuals represent, and the species those populations comprise in more detail as required. We also consider whether the action will result in impacts to the essential physical and biological features (essential features) and conservation value of designated critical habitat. The effects analysis for those activities that are likely to adversely affect ESA-listed species or designated critical habitat is general for those activities (i.e., icebreaking) that will require step-down consultations as the details of the activities are provided by the USCG and/or NMFS Permits and Conservation

Division as new icebreakers are constructed and MMPA authorization is requested for their operation.

*Cumulative Effects* (Section 9): Cumulative effects are the effects to ESA-listed species and designated critical habitat of future state or private activities that are reasonably certain to occur within the action area (50 C.F.R. §402.02). Effects from future Federal actions that are unrelated to the action are not considered because they require separate ESA section 7 compliance.

*Integration and Synthesis* (Section 10): With full consideration of the status of the species and the designated critical habitat, we consider the effects of the action within the action area on populations or subpopulations and on essential features when added to the environmental baseline and the cumulative effects to determine whether the action could reasonably be expected to:

- Reduce appreciably the likelihood of survival and recovery of ESA-listed species in the wild by reducing its numbers, reproduction, or distribution, and state our conclusion as to whether the action is likely to jeopardize the continued existence of such species; or
- Appreciably diminish the value of designated critical habitat for the conservation of an ESA-listed species, and state our conclusion as to whether the action is likely to destroy or adversely modify designated critical habitat.

The results of our jeopardy analysis are summarized in the *Conclusion* (Section 11). If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, then we must identify Reasonable and Prudent Alternative(s) to the action, if any, or indicate that to the best of our knowledge there are no reasonable and prudent alternatives. See 50 C.F.R. §402.14(h)(3).

For a mixed programmatic consultation, an *Incidental Take Statement* (Section 12) is included for those actions where no step down consultation will occur and take of ESA-listed species is reasonably certain to occur. We anticipate that additional ITSs will be issued for step-down formal consultations for those activities likely to adversely affect ESA-listed species in keeping with the revisions to the regulations specific to ITSs (80 FR 26832, May 11, 2015; ITS rule). The ITS specifies the impact of the take, reasonable and prudent measures to minimize the impact of the take, and terms and conditions to implement the reasonable and prudent measures (ESA section 7 (b)(4); 50 C.F.R. §402.14(i)).

We provide discretionary *Conservation Recommendations* (Section 13) that may be implemented by the action agency (50 C.F.R. §402.14(j)). Finally, we identify the circumstances in which *Reinitiation of Consultation* (Section 14) is required (50 C.F.R. §402.16).

## 2.1 Evidence Available for the Consultation

To comply with our obligation to use the best scientific and commercial data available, we collected information identified through searches of Google Scholar, literature cited sections of peer reviewed articles, species listing documentation, and reports published by government and private entities. Searches were used to identify information relevant to the potential stressors (icebreaking, training, vessel transit, and other operations) and responses of ESA-listed species and designated critical habitat. This Opinion is based on our review and analysis of various information sources, including:

- Information submitted by the USCG and/or NUWC
- Government reports
- Peer-reviewed scientific literature

These resources were used to identify information relevant to the potential stressors and responses of ESA-listed species and designated critical habitat under NMFS jurisdiction that may be affected by the action to draw conclusions on risks the action may pose to the continued existence of these species and the value of designated critical habitat for the conservation of ESA-listed species.

In terms of acoustic criteria and information to enable us to evaluate the effects of different sound sources on ESA-listed species in this consultation and our biological opinion, the NMFS ESA Interagency Cooperation Division coordinated with the NMFS Permits and Conservation Division to review the modeling and other data provided by the USCG and the Navy (Appendix A). Although our current use of acoustic criteria and acoustic thresholds represents the best available science at this time, we have identified the need to re-evaluate acoustic criteria and thresholds specific to icebreaking noise (see Appendix B). However, it is important to note that while changes in acoustic criteria may affect the enumeration of "takes," they do not necessarily significantly change the evaluation of population-level effects or the outcome of a jeopardy analysis. The programmatic framework of this consultation with the requirement for step-down consultation will also enable NMFS and the USCG to regularly address new information and allow for modification of mitigation and/or monitoring measures as appropriate. If new information is identified that would potentially change our conclusions on population-level effects of our jeopardy analysis, reinitiation of consultation may be required.

### 2.1.1 The Navy Acoustic Effects Model (NAEMO)

The NUWC has been modeling the potential acoustic effects of Navy training and testing activities on marine mammals and sea turtles since 1997. Fish are not included in the model. Early models used area density approaches in which acoustic footprints were computed and then multiplied by animals densities to calculate effects. As a result of a review by the Center for Independent Experts, the Navy Acoustic Effects Model (NAEMO) became the standard model used by the NUWC to estimate the potential acoustic effects of proposed Navy training and testing activities on marine mammals and sea turtles.

Modeled effects from NAEMO were used to support the USCG's analyses in the BE and EIS prepared for the action. Information specific to how NAEMO was used to quantify potential effects to marine mammals from icebreaking activities taken from the 2017 BE for the action is included in Appendix A. Appendix B contains a summary of proposed changes to the model to address NMFS concerns regarding the limitations of current data and the NAEMO modeling to adequately account for the impacts of non-impulsive sounds generated by icebreaking on marine mammals, including bowhead whales and ice seals. Because NMFS has concerns regarding the methodology and data used in the NAEMO to generate conclusions regarding the exposure of marine mammals to the acoustic effects of icebreaking, the NUWC will create a Working Group composed of representatives from NMFS, USCG, NUWC, and subject matter experts from other entities, institutions, and agencies to further refine the model. The formation of the Working Group will begin prior to completion of the first new icebreaker and any associated MMPA authorization. The information from this Working Group will be applied to step-down consultations associated with each MMPA authorization.

# 3 DESCRIPTION OF THE ACTION

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (50 C.F.R. §402.02).

The USCG proposes the design and build of up to six heavy and medium icebreakers with planned 30-year service lives. Icebreakers are transoceanic vessels that travel worldwide to support the USCG's missions in the Antarctic and Arctic. An icebreaker is a special type of vessel designed to navigate through ice-covered waters and provide safe passage for other boats and ships. Icebreakers are one of the largest cutters operated by the USCG. A ship with 45,000 or more brake horsepower (of the ship's power plant; the available power of an engine assessed by measuring the force needed to brake the ship) can be considered a heavy polar icebreaker while a ship with 20,000 to 44,999 brake horsepower can be considered a medium polar icebreaker (O'Rourke 2015).

Heavy icebreakers are defined as ships that have icebreaking capability of 6 feet (ft) of ice continuously at 3 knots and can back and ram through at least 20 ft of ice (NAS 2005). The USCG's polar icebreaker classification requires the icebreaker have propulsion power greater than 10,000 horsepower and a minimum displacement of 6,000 tons (NAS 2005). The CGC POLAR SEA has a reinforced hull and up to 75,000 horsepower and can break up to 21 ft of ice continuously at 3 knots. Polar Class icebreakers carry a smaller vessel or vessels such as an Arctic Survey Boat or Landing Craft on board and are equipped with a flight deck for USCG helicopters. Heavy icebreakers are specifically designed for icebreaking; having reinforced hulls, special icebreaking bows, and a system that allows rapid shifting of ballast to increase the effectiveness of their icebreaking. The shell plating and associated internal support structure are fabricated from steel that has especially good low-temperature strength. The portion of the hull designed to break ice is 1.75 inches (44 mm) thick in the bow and stern sections, and 1.25 inches (32 mm) thick amidships. The hull strength is produced almost entirely from the massive internal support structure. The CGC POLAR STAR's hull shape is designed to maximize icebreaking by efficiently combining the forces of the ship's forward motion, the downward pull of gravity on the bow, and the upward push of the inherent buoyancy of the stern. The curved bow allows the CGC POLAR STAR to ride up on the ice, using the ship's weight to break the ice. It is expected that any heavy PSC would also have similar design, capabilities, and conduct similar operations to the CGC POLAR STAR. While these vessels can conduct operations in the Arctic and Antarctic, they are the primary icebreaker that clears the channel into McMurdo Station for supply ships.

Medium icebreakers such as the CGC HEALY have less ice breaking capability (up to 4.5 ft of ice continuously at 3 knots or ice 10 ft thick when backing and ramming; O'Rourke 2015). The CGC HEALY, the Coast Guard’s only medium icebreaker that is currently operational, is an optimally manned vessel, meaning she has the minimum number of personnel staffed in order to safely navigate. Due to the vast array of missions conducted by the CGC HEALY, it is vital that crewmembers are fully qualified on a number of duties. Helicopter support may also be provided for passenger transfer or specific scientific missions on medium icebreakers. The CGC HEALY has more capability for supporting scientific research but future medium icebreakers considered under this consultation may or may not share that capability.

The new vessels would not all be built and deployed at the same time but instead in a staggered fashion with the first icebreaker expected to be delivered as soon as 2023. Subsequent vessels would be built at a frequency of 1.5 years or longer from when the first new icebreaker is deployed and operational. The first vessel to be constructed will be a heavy PSC.

The location or locations where new vessels will be constructed may vary based on the acquisition process for each vessel, which would affect the one-time transit route from the shipbuilding facilities where each vessel is constructed to the homeport of the new vessels. At this time, the USCG anticipates that Seattle, Washington, where the icebreakers that are currently operational are homeported, will also be the homeport for the new vessels. However, the homeport for the new vessels may change based on the size of the vessels in relation to the water depth and other characteristics of the current homeport, as well as future changes in operational focus for some or all of the vessels.

### 3.1 Authorities under which the Action will be Conducted

The USCG missions are guided by the USCG's Arctic Strategy and Arctic Strategy Implementation Plan (USCG 2015), the National Security Strategy, National Military and Maritime Strategies, National Strategy for the Arctic Region, Arctic Region Policy NSPD-66/HSPD-25, National Strategies for Homeland Security and Maritime Domain Awareness, National Ocean Policy, and Executive Order 13580 (Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska, issued on July 12, 2011).

Law enforcement missions, including any icebreaker support of law enforcement activities, are covered under USC Title 14 and Part 468.

The MMPA of 1972 established a moratorium on the taking of marine mammals in U.S. waters. The MMPA defines “take” to mean “to hunt, harass, capture, or kill” any marine mammal or attempt to do so (16 USC § 1362(13)). NMFS Permits and Conservation Division can permit actions as exceptions to the moratorium for take incidental to commercial fishing and other non-fishing activities, for scientific research, and for public display at licensed institutions such as aquaria and science centers. The MMPA was amended in 1994 to define two levels of harassment: Level A for injury and Level B for behavioral disturbance. Level A harassment means any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or mammal stock in the wild. Level B harassment refers to acts that have the potential to disturb (but not injure) a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. Activities resulting in serious injury or mortality and/or activities resulting in harassment (i.e., injury - Level A, and/or disturbance - Level B) of marine mammals require MMPA authorization.

### 3.2 Proposed Activities

The new icebreakers will be incorporated into the USCG's fleet to provide land/shore, air, and sea operations, conduct training exercises, and participate in tribal and local government engagement to meet the USCG's mission responsibilities due to the expected surge in activities in the polar regions. The new icebreakers would be designed to carry out the following USCG fundamental roles, similar to the polar icebreakers that are currently in operation:

- Ice operations
- National defense
- Maritime security
- Maritime mobility
- Protection of natural resources
- Maritime safety/search and rescue

The new icebreakers, along with other USCG assets, would perform these fundamental roles and the duties, functions, and missions of the USCG that include the following:

- Searching for and rescuing either passengers and crew that fall overboard from recreational, commercial, or government vessels in Arctic or Antarctic waters, or victims of crashed aircraft in the water
- Rescuing persons on vessels in Arctic or Antarctic waters in medical scenarios requiring evacuation by USCG helicopter or rescue vessel, sometimes requiring a USCG rescue swimmer to enter the water to place the person in a harness or rescue basket to be winched into a hovering helicopter
- Freeing a beset vessel, which may require towing or escorting to safety
- Breaking ice to allow safe passage to vessels or to free beset vessels
- Establishing aids-to-navigation in Arctic waters
- Enforcing federal law in U.S. Territorial Sea and the High Seas of Arctic waters

- Maintaining awareness of vessel and aircraft activities in the Arctic maritime domain
- Broadening USCG partnerships with Alaska Native Villages in the Arctic
- Enhancing and improving preparedness, prevention, and response capabilities
- Oil spill response, mapping, and science.

Of the duties, functions, and missions listed above, the following are part of this consultation, which does not include emergency response:

- General vessel operations, including vessel transit
- In-ice testing
- Passenger transfer by vessel
- Air operations, including vertical replenishments, ice reconnaissance, and passenger transfer
- Icebreaking to free a beset vessel and to allow safe passage of vessels
- Towing or escorting vessels
- Law enforcement in U.S. Territorial Sea and the High Seas of Arctic waters
- Training activities using vessels and/or aircraft, including oil spill training to improve preparedness, prevention, and response capabilities.

Table 1 provides a summary of the activities to be conducted as part of icebreaker operations and identifies the primary operation areas where these activities will take place. Vessel transit areas are not included in the table and will be discussed further in Section 4 of this Opinion. Of the activities listed in Table 1, diver training may occur during vessel transit to/from operation areas in the Arctic, Antarctic, and Pacific Northwest (see Section 3.2.2.9).

**Table 1. Summary of proposed activities in operation areas (adapted from USCG 2019)**

| **Activity** | **Operation Area** | | |
|---|---|---|---|
| | **Arctic** | **Antarctic** | **Pacific Northwest** |
| **Vessel Operations** | | | |
| Icebreaking | X | X | |
| Maneuverability-Propulsion Testing | | | X |
| Manueverability-Ice and Bollard Condition Testing | X | | |
| Vessel Escort[1] | X | X | |
| Vessel Tow[1] | X[1] | X | |
| Passenger and Science Transfer | X | X | |
| Law Enforcement | X | | |
| Search and Rescue Training[1] | X | X | |
| Scientific Support Missions[2] | X | X | |

| | | | |
|---|---|---|---|
| Autonomous Underwater Vehicle (AUV) Deployments | X | | |
| Diver Training and Dive Team Operational Functions | X | X | X |
| Fueling Underway | X | X | |
| Gunnery Training | X[3] | | X[3] |
| Marine Environmental Response Training | X | | X |
| **Aircraft Operations** | | | |
| Landing Qualifications | X | X | |
| Reconnaissance | X | X | |
| Vertical Replenishments and Mission Support | X | X | |
| Community Outreach and Passenger Transfer | X | X | |
| [1] This consultation excludes emergency response with the exception of training activities for emergency response preparedness. In the Arctic, vessel towing could occur, but is considered to be rare, as is towing of ice pier from McMurdo Station in Antarctic. [2] USCG personnel may participate in scientific surveys as part of the Coast Guard mission, but those scientific research activities would be covered under any required permits obtained by the researcher. [3] In the Pacific Northwest, gunnery training would occur in the open ocean or on established U.S. Navy Ranges. In the Arctic, gunnery training could occur in the Bering Sea but is considered rare due to weather limitations. | | | |

Emergency response activities are not included in this consultation. Individual emergency consultations will be conducted for emergency response activities on an as-needed basis. Based on information from the USCG, marine environmental response (i.e., oil spill response) and emergency vessel escorts occur infrequently (less than once every three to four deployments) and one search and rescue (SAR) operation every three to four deployments. The USCG has developed a number of mitigation measures in cooperation with the Services as part of past emergency consultations and will continue to develop additional measures, as needed, as part of future individual emergency consultations. However, training activities associated with SAR (Section 3.1.2.6) and emergency response preparedness (Section 3.1.2.9) using the icebreakers are included in this programmatic consultation. Additionally, non-emergency vessel escort and tow (Section 3.1.2.3) are also included in this programmatic consultation.

The following subsections provide details of the activities that will be conducted once the new icebreakers have been constructed and are in training and testing areas in the Pacific Northwest, Arctic, and Antarctic, operation areas in the Arctic and Antarctic, and transiting to these areas. Table 2 provides a summary of the expected frequency per year and number of hours over which each activity is expected to occur in the Arctic, Antarctic, and Pacific Northwest operation areas.

Vessel transit is not included in the table and will be discussed further in Section 4. Patrols would encompass all activities in Table 2 and are therefore not included as a separate activity.

This consultation analyzed the effects to ESA-listed species and designated and proposed critical habitat resulting from future actions associated with the operation of the new icebreakers by the USCG. However, while the following activities are included in this consultation:

- Icebreaking
- Ice condition testing
- Bollard condition testing
- Vessel escort and tow
- Aircraft operations

step-down consultations with NMFS Permits and Conservation Division and the USCG will likely be required for these activities and their implementation as part of the required MMPA authorization for new vessels and their operation. The effects of these activities (Sections 6.1 and 8), the incorporation of the appropriate PDCs (Section 3.5) to avoid and minimize impacts to ESA-listed species and their designated critical habitat, and take incidental to these activities are considered to the extent possible in this Opinion, but additional PDCs and/or incidental take authorization may be necessary for some or all of these activities in the future.

Due to the nature of the rest of the activities associated with the operation of the new icebreakers and our history of consultation with the USCG and other Federal agencies for similar activities, patrols, the use of navigation equipment during vessel operation, anchoring, dive team operations, post-delivery and propulsion testing, towing of the McMurdo ice pier, passenger and science transfer, law enforcement, SAR training, use of autonomous underwater vehicles (AUVs), diver training, emergency response training, gunnery training, fueling underway, and vessel noise associated with the operation of the icebreakers and smaller support vessels will not require step-down consultation unless the nature and scope of these activities changes in a way that would result in effects to ESA-listed species and designated critical habitat that was not considered in this Opinion, triggering reinitiation (Section 14). The effects of these activities are fully considered in this Opinion (Sections 6.1 and 8.1) and any take incidental to the proposed activities exempted through the ITS associated with this Opinion. These activities will incorporate the appropriate PDCs (Section 3.5) to avoid and minimize impacts to ESA-listed species and their designated critical habitat.

**Table 2. Frequency per year and number of hours each activity will occur in the different operation areas (adapted from USCG 2019)**

| Activity | Operation Area(s) | Frequency per Year | Hours per Activity |
|---|---|---|---|
| Icebreaking Full Power[1] | Arctic | 5 | Up to 16 |
| | Antarctic | 4 | Up to 16 |
| Icebreaking Half Power[1] | Arctic | 5 | Up to 16 |
| Icebreaking Quarter Power[1] | Arctic | 11 | Up to 16 |
| | Antarctic | 22 | Up to 16 |
| Maneuverability – Propulsion Testing (Sea Trials) | Pacific Northwest | 1 | Up to 2[2] |
| Maneuverability – Propulsion Testing (Post-Delivery Trials) | Pacific Northwest | 1 | Up to 2[2] |
| Maneuverability – Ice Condition Testing | Arctic | Once every 10 years | Up to 6[2] |
| Maneuverability – (In Ice) Bollard Condition Testing | Arctic | Once every 10 years | 2 |
| Vessel escort | Antarctic | 2 | 4 to 16 |
| | Arctic | 1 | 24 |
| | Antarctic/Arctic | 1 | 48 |
| Vessel Tow | Antarctic | 1 | 1 to 48 |
| Vessel Operations: Passenger Transfer | Artic | 5 | Up to 12 |
| | Antarctic | 4 | Up to 12 |
| Vessel Operations: Law Enforcement | Arctic (Bering Sea) | 20 | Up to 12 |
| SAR Training | Arctic | 1 (each location) | 4 to 12 |
| | Antarctic | | |
| AUV Deployments | Arctic | Twice per patrol | Up to 24 |
| Diver Training | Pacific Northwest | To maintain proficiency: once per month (warm season) or every other patrol; In ice: Twice per deep freeze; For science: Twice per patrol | 2 |
| | Antarctic | | |
| | Arctic | | |
| Fueling Underway | Arctic | | 3 |

| | | | |
|---|---|---|---|
| | Antarctic | Once every 5 years | |
| Gunnery Training | Pacific Northwest (Open Ocean or Navy Range) | 2 | 1 |
| Marine Environmental Response Training | Pacific Northwest | 2 (each location) | 3 to 5 |
| | Arctic | | |
| Aircraft Operations: Landing Qualifications[3] | Arctic | Every 21 days | Flight operation duration: 4 hours; Qualification evolution: 1 day |
| | Antarctic | | |
| Aircraft Operations: Ice Reconnaissance[3] | Arctic | 2 (each location) | 2 |
| | Antarctic | | |
| Aircraft Operations: Vertical Replenishment and Mission Support[3] | Arctic | 2 | 16 |
| | Antarctic | 1 | 16 |
| Aircraft Operations: Community Outreach, Passenger Transfer[3] | Arctic | 4 (each location) | 2 to 4 |
| | Antarctic | | |

[1] Icebreaking is dependent on ice cover. Time estimated in this table are based on averages from past years.

[2] Maneuverability testing would be 2 to 6 hours (depending on activity) and may occur over two consecutive days.

[3] Helicopters would likely be the aircraft supporting these activities.

### 3.2.1 Patrols

Icebreakers would patrol in the Arctic and Antarctic operation areas to provide a USCG presence. An average patrol is 80 days, including time the vessel spends icebreaking, loitering, and transiting. Patrols by icebreakers would not occur in the Pacific Northwest operation area.

Patrol schedules and deployments vary depending on the number of icebreakers that are active in the fleet. The USCG proposes up to six new icebreakers, potentially divided between medium icebreakers and heavy PSCs. As stated in the Programmatic Environmental Impact Statement (PEIS), the USCG used three icebreakers to provide an example of deployment scenarios for each of the polar regions because this is the minimum number necessary for the action (USCG 2019).

Each icebreaker deployed to the Arctic operation area would perform two three-month patrols per calendar year with no more than two vessels in the Arctic at a time if six vessels are constructed and commissioned. If only three vessels are constructed, then two of the icebreakers could alternate deployment to the Arctic while the third would be in dry dock for maintenance. Regardless of whether three or six vessels are constructed and commissioned, the USCG could maintain icebreaker presence on patrol in the Arctic year-round.

In the Antarctic operation area, the USCG would perform seasonal patrols. If only three icebreakers are constructed and commissioned, then one would patrol in the Antarctic and one in the Arctic while the third remains in dry dock for maintenance. It is expected that each year there will be at least one, up to two, icebreaker patrols in the Antarctic with an icebreaker on patrol for 4.5 months at a time, including transit to, in, or from the Antarctic operation area.

### 3.2.2 Vessel Operations

The vessel operations of icebreakers listed in Table 1 and the timing of activities associated with vessel operations in Table 2 are described further in the subsections below. All vessels will be equipped with standard navigational technologies, including fathometers (depth sounders, which are single-beam echosounders also called fathometers), radar, and navigational sonar. The single-beam echosounder is part of the vessel's navigational system that would be on at all times while a vessel is underway (potentially up to 24 hours) though the transmitted pulses are of short duration, typically milliseconds. The sound frequencies can range from 3.5 to 1,000 kilohertz (kHz); however, most navigational systems operate from 50 to 200 kHz, which is the assumed operating frequency for the action (USCG 2019). The maximum transmit powers may be as high as 227 decibels referenced at 1 micropascal at 1 meter root mean square (dB re: 1 µPa @ 1 m rms), depending on frequency with the highest levels used in low-frequency, deepwater applications. During the action, the sound source level is not expected to be higher than 200 dB re: 1 µPa @ 1 m rms. The most common geometry is one conical vertical beam with side lobes that may generate unwanted energy outside the main lobe, but are typically 20 to 30 dB below the main lobe's level. The pulse durations are normally about 0.1 to 1 percent of the echo reception delay, typically between 0.1 and 10 milliseconds with longer pulses corresponding to lower frequencies and deeper waters.

Doppler Speed Logs (ADCPs) are low-frequency sonar instruments used primarily for research purposes to measure the vessel's relative speed by solving the Doppler equation using Doppler effects on transmitted/reflected sound waves in the water through which it is traveling (the Doppler effect is observed as a frequency shift resulting from the relative motion between a transmitter and receiver or reflector of acoustic or electromagnetic energy). The Doppler Speed Log has a transducer that emits a continuous, high frequency sound pulse (working frequency varies with instrument with some single axis instruments having a working frequency of 715 kHz) in the forward direction of the vessel at a 60 degree angle to the keel. The higher the sound frequency and the smaller the transducer, the narrower the beam and the higher the accuracy of the equipment. The beam bounces back from the sea bottom or off particles in the currents, layer by layer, including the bottom, taking speed-over-ground (SOG) into account. When the signal is bounced off the sea bed (called Bottom Track), the speed displayed is the SOG. The frequency of the bottom echo will be higher when the ship is moving ahead and lower if the ship is moving astern. New icebreakers will be modulated for an ADCP but may or may not have one onboard due to its primary use in research.

Motor noise from small vessels used as part of training and routine patrols is estimated as having a frequency range of 1 to 7 kHz and a source level of 175 dB re: 1 μPa @ 1 m rms while underway. Motor noise from large vessels, including the new icebreakers, is estimated as having a frequency range of 0.02 to 0.30 kHz and a source level of 190 dB re: 1 μPa @ 1 m rms while underway (USCG 2019). The USCG does not have information on the sound signature for each vessel in its fleet so it used the best available science for similar vessels operations in a similar manner as in the action. Richardson et al. (1995b) contains measured frequencies and source levels for a variety of small boats ranging in size from 5 to 34 m in length, as well as a trawling vessel. Richardson et al. (1995b) cites a source level of 175 dB re: 1 μPa @ 1 m rms for a large outboard engine and points out the dominant frequencies are higher for outboard motors than for larger vessels.

Icebreakers will not anchor while in transit but may anchor at a port if facilities for docking an icebreaker are not available, although docking is preferred and icebreakers will typically use ports that can support these types of vessels. If anchoring at port facilities is required, it would occur in designated anchorage areas. In ports such as Seattle, Washington, and Kodiak and Dutch Harbor, Alaska, the icebreakers would berth at a pier. Utqiagvik/Barrow cannot support docking of the current icebreaker fleet so it is assumed that the new icebreakers would need to anchor at this location.

Other vessel operations that are considered in this Opinion are associated with transit including:

- Icebreaker transit from the shipbuilding facility or facilities
- Icebreaker transit to/from the homeport of the new icebreakers (assumed to be Seattle, Washington at this time) to the Arctic and Antarctic operation areas and the areas in the Pacific Northwest where training and testing activities are proposed.
- Icebreaker transit to/from other harbors (including Kodiak and Dutch Harbor) for refueling, supplies, or other purposes.

Dive teams may be present on an icebreaker during patrols and would participate in diver training activities to maintain proficiency. The new icebreakers will have designated space for a dive locker with a portable hyperbaric chamber to execute dive operations and respond to diving emergencies. Operational functions that may use dive teams include: maintenance, repair, and protective measures including ship husbandry, hull inspections, cofferdam placement and removal, plugging and patching, zinc placement and removal, and hull protection sweeps. Hull protection sweeps would be conducted only when the vessel is at a port on high alert. Ship husbandry, cofferdam placement and removal, and plugging and patching are expected to occur infrequently. Cofferdams are small, temporary barriers constructed by the ship's crew when needed that are placed on the hull of the ship by divers in order to facilitate work on through-hull fittings. Hull inspections would occur once per patrol when the icebreaker moves out of the ice, as long as a dive team is aboard the vessel. Zinc placement and removal would only occur in a port in the Arctic operation area and would not occur in the Antarctic operation area.

Divers may also be used for science missions, but these activities would be covered under separate scientific permits and are not included in this consultation.

#### *3.2.2.1 Icebreaking*

Icebreaking would occur in ice covered areas in the Arctic and Antarctic operation areas only when needed. The amount of time a new icebreaker would spend icebreaking will vary based on the need and ice cover. Icebreaking could last up to 16 hours each day, but the actual amount of time the icebreaker would be icebreaking in a 24-hour period is expected to be less than the maximum (i.e., less than 16 hours per day). During icebreaking operations, vessel speed would range from 3 to 6 knots, and may be slower when breaking heavy ice. Engine power and the amount of time the engine runs at a certain power could also vary based on the type of icebreaking required. Icebreaking can occur under full, half, or quarter power. The general method for icebreaking is to drive the ship up on top of the ice until the weight of the ship breaks the ice. Icebreakers often need to scarf the edge (shave down the lip of ice with ship's hull) of the initial channel created through the ice by the vessel to widen it. The USCG expects the new icebreakers to use the same method to break ice in the Arctic and Antarctic operation areas. The noise generated by icebreaking operations is expected to have a frequency range of 0.025-12.8 kHz and 164-189 dB re 1 microPa @ 1 m (USCG 2019). Erbe and Farmer (2000) calculated a median source level of 197 dB re: 1 μPa rms at 1 m between 100 Hz and 22 kHz. For the subsequent analysis of ramming noise, Erbe and Farmer (2000) chose the loudest cavitation noise (i.e., the 95th percentile) with a corresponding source level of 205 dB re 1 microPa at 1 m.

Icebreaking in the Arctic operation area would occur most often from spring to fall, although the exact timing would be dictated by the ice extent. Icebreaking may be required year-round as ice conditions change. During an Arctic patrol, there would be an average of 21 days of icebreaking that could occur anywhere within the Arctic operation area where there is ice.

In the Antarctic operation area, icebreaking would support the break-in of McMurdo Station and Marble Point in the austral summer (December to February). During an Antarctic patrol, there would be an average of 26 days of icebreaking. Icebreaking may also include towing a vessel to open water once per year and vessel tows off a pier up to twice per year based on historic operations information for the Antarctic operation area.

#### *3.2.2.2 Functionality and Maneuverability Testing*

Functionality and maneuverability testing for a new icebreaker would be similar to that conducted for the current fleet of the USCG icebreakers, including propulsion testing, ice condition testing, and bollard testing in ice. These activities are discussed in more detail below.

As discussed previously, the USCG assumed the homeport for the new icebreakers will be Seattle, Washington. Therefore, the Pacific Northwest is the proposed location of functionality and maneuverability testing, although the USCG, in its response to questions from NMFS sent on October 1, 2018, noted that propulsion and maneuverability testing may also occur off Vallejo, California.

If the homeport of some or all of the new icebreakers changes, resulting in changes in the location of functionality and maneuverability testing and associated changes in potential effects to ESA resources, a step-down consultation would be required to evaluate these changes.

Post-Delivery Testing

Post-delivery maneuverability testing would occur in the Pacific Northwest operation area and would be conducted to validate the control and maneuverability of the icebreaker after dry dock. Testing would run for up to two hours at a time with the vessel moving at full power over one or two days. During this testing, the depth sounder would be operated.

Propulsion Testing

Propulsion testing consists of two-day sea trials and occurs after dry dock and post-delivery testing. Propulsion testing would occur in the Pacific Northwest operation area in ice-free waters. Testing would consist of the icebreaker running at speeds between 12 and 17 knots and executing various maneuvers (i.e., straight line or tight turning maneuvers). Additionally, a turning circle or radius test would be conducted to find out how much area is needed to turn the vessel. During this testing, the depth sounder would be operated.

Ice Condition Testing

Ice condition testing would occur once per decade in the Arctic operation area. Ice condition testing for the icebreaker would consist of a training test for a channel departure and star maneuver. A channel departure training test would occur mainly in ice so the crew can train how to exit from an area once the icebreaker breaks through the ice. The star maneuver also occurs in ice and refers to when an icebreaker creates a wider channel, moving forward and backward in a star-shaped pattern to break out of the ice. It is expected that an icebreaker would take approximately two days to move into the ice and testing would then last for up to six hours. Because the icebreaker would be in areas of heavy sea ice, the transiting speed would be low (approximately 3 knots with a maximum speed of 6 knots).

Bollard Condition Testing

Bollard pull or push condition testing would occur in ice once per decade in the Arctic operation area. Bollard pull refers to the pulling (or towing) power of a watercraft, defined as the force (in tons or kiloNewtons) exerted by a vessel under full power, commonly measured in a practical test (but sometimes simulated) under certain test conditions (e.g., calm water, ice, etc.). The icebreaker would sit stationary, secured to a pier, with its engine at full power after a slow increase to full power or a rapid increase to full power. The icebreaker's engines would work at

110 percent of its power for two hours. After this test is completed, the icebreaker needs a 24-hour recovery period.

Bollard push refers to the pushing of a large feature ahead and astern. This testing may increase noise levels in the immediate testing area when compared to typical engine noise produced by conventional icebreaker operations because the engine is running at 110 percent for two hours.

#### *3.2.2.3 Escorting Vessels and Towing*

Emergency escorts or tows are not part of the action considered in this programmatic opinion. Emergency escorts or tows would be part of individual emergency response consultations and are expected to occur infrequently (less than once every three to four patrols based on information provided by the USCG). Non-emergency escorts or tows are rare in the Arctic operation area and more likely in the Antarctic operation area based on historic information. It is expected that a new icebreaker will perform vessel escort and tow in the same manner as the current USCG fleet.

<u>Vessel Escort</u>

When escorting a vessel in ice, the icebreaker creates a channel for the vessel to follow behind at speeds of 4 to 5 knots. Based on the average number of escorts by other USCG assets in the Arctic operation area, a vessel escort requiring the use of an icebreaker may occur once per year. An Arctic escort may last up to 24 hours. An icebreaker may also perform a convoy escort (escorting multiple vessels) in the Arctic operation area, although this is rare based on past history of USCG vessel operations in the area.

An icebreaker would be expected to escort a vessel an average of two times per year in the Antarctic operation area to McMurdo Station based on historical locations and average number of escorts by the current fleet of USCG icebreakers. Vessel escorts in the Antarctic operation area around McMurdo Station and into the pier located there last approximately four hours, but a maximum of 16 hours of operation is possible.

It is anticipated there could be up to 48 hours of additional escorts annually in either operation area (Arctic and Antarctic).

<u>Vessel Tow</u>

The icebreaker's engine typically runs at a quarter power during vessel tow. Speeds of 4 to 5 knots are typical for a vessel tow. Vessel tows last up to 48 hours. Icebreaking may also be needed during vessel tow and is expected to take less than 4 hours.

Based on historic information, towing of vessels has occurred in the Antarctic operation area only and included tows to open water once per year and tows off a pier at McMurdo Station twice per year. Tows off the pier took approximately one hour as the icebreaker pulled the vessel off the pier and released it to travel under its own power. The icebreaker crew will conduct annual vessel tow training in the Antarctic operation area only.

A vessel tow could occur in the Arctic operation area, but is not expected based on historic operations information.

<u>Other Towing</u>

There is an ice pier constructed by the National Science Foundation (NSF) with steel cable, mesh, pipe, bollards, and wooden poles embedded in a man-made sheet of ice at McMurdo Station. On February 14, 2003, the U.S. Environmental Protection Agency (EPA) issued a general permit to the NSF for ocean disposal of man-made ice piers from the NSF base at McMurdo Sound, Antarctica. The EPA renewed the general permit for NSF on April 22, 2014 (79 FR 22488, April 22, 2014). Issuance of a permit is necessary because the pier is towed to sea for disposal at the end of its effective life.

The ice pier at McMurdo Station is approximately 325 ft long by 150 ft wide by 15 ft thick and is covered with gravel to provide a non-slip surface. The ice pier has a normal life span of three to five years. At the end of the ice pier's effective life, the wooden poles, bollards, and steel pipes are severed just above the surface of the ice, the gravel is removed to the extent possible, and all transportable equipment, materials, and debris are removed. The pier is cast loose and towed as close to the Ross Sea currents as possible by an icebreaker (that may be a USCG vessel or not) where the pier disintegrates as the ice melts and construction materials that remain embedded in the ice are released to the sea. Thus, the new icebreakers may periodically tow the ice pier away from the station.

However, only the towing of the pier away from the Station is included in the action considered in this programmatic consultation. Based on information from NSF, no pier has been towed to sea since 2004 because the piers have been detaching on their own. NSF now removes structures and materials from the pier when it starts to deteriorate and puts a tracking beacon on the pier before it detaches naturally (pers. comm. from P. Penhale, NSF, to L. Carrubba, NMFS, December 20, 2018). Because towing of the pier is rare, PDCs are included for this activity (Section 3.3.1), which will not require further consultation unless changes requiring further analysis occur because implementation of the PDCs will ensure impacts to ESA resources are avoided and minimized.

The construction, and removal and disposal of the pier is the responsibility of the NSF and the disposal of the pier in ocean waters is authorized by the EPA. Therefore, NSF and EPA are responsible for any required compliance with the ESA for the periodic construction, disposal, and reconstruction of the ice pier at McMurdo Station.

#### *3.2.2.4 Passenger and Science Transfer*

The new icebreakers will have landing craft capability. Small support vessels deployed from the icebreaker would bring crew members or scientists and their gear, and/or equipment from the vessel to shore and from shore to the vessel. Passenger transfers would occur over 12 hours with two hours spent on the support vessel(s). There may be up to two support vessels transferring passengers as each icebreaker would carry up to two support boats for passenger and equipment transfers. Support boats would travel at a maximum speed of 15 knots. Transfers would typically occur when icebreakers are no more than 10 to 12 nautical miles (nm) from the point of transfer. During these transfers, the USCG would use radar communications, including S-band, commercial off-the-shelf, and antenna (radio).

In the Arctic operation area, there would be general passenger transfers and sciene transfers. General passenger transfers would occur two times per patrol, typically from the icebreaker to Nome, Barrow/Utqiagvik, or Dutch Harbor. Three science transfers are expected in the Arctic action operation area per patrol, but the schedule would be dependent on need.

General passenger transfers and science transfers would also occur in the Antarctic operation area. General passenger transfers would occur twice per patrol and science transfers would also occur two times per patrol from the icebreaker to McMurdo Station.

The exact location of the science transfers are dependent on the research. Details of the research, as well as associated potential impacts to ESA resources, would be covered under the ESA section 7 consultations conducted by NMFS for each scientific permit.

#### *3.2.2.5 Law Enforcement*

Icebreaker support of law enforcement activities is considered part of the action (e.g., support vessel activities), including associated USCG law enforcement training conducted from the vessels. The Protected Living Marine Resources Program (Coast Guard Command Instruction 16475.7) outlines actions during USCG operations to support the recovery of protected living marine resources through internal compliance with and enforcement of Federal, State, and international laws designed to preserve marine protected species.

Law enforcement vessel boardings would occur in the Bering Sea and in the open ocean of the Arctic operation area. During the transit portion of each icebreaekr patrol, there would be approximately two weeks of law enforcement activities during which the USCG would deploy up to two over-the-horizon boats from the icebreaker to board fishing vessels. Over-the-horizon boats would travel less than a mile from the icebreaker at roughly 30 knots. Boarding operations average a maximum of 12 hours.

Reconnaissance using helicopters is also used as part of law enforcement activities. Based on historical information on law enforcement reconnaissance, helicopters are flown at an altitude that allows them to locate the object they are looking for and is often 1,000 ft or lower based on the size of the targets. If reconnaissance is covert and weather conditions allow, helicopeters could be flown above 1,500 ft (457 m). In the future, unmanned aircraft systems (UASs) may be used to conduct reconnaissance for law enforcement missions but are not currently employed in this capacity during icebreaker operations.

Statutory missions described for living marine resources law enforcement and other law enforcement include the following elements:

- project federal law enforcement presence over the entire EEZ, covering nearly 3.4 million square miles (8.8 million square kilometers) of ocean
- ensure compliance with fisheries and marine protected species' regulations on domestic vessels
- prevent overfishing, reduce mortality of protected species, and protect marine habitats by enforcing domestic fishing laws and regulations
- enforce the MMPA and the ESA
- enforce foreign fishing vessel laws
- patrol the EEZ boundary areas to reduce the threat of foreign poaching of U.S. fish stocks
- monitor compliance with international living marine resource regimes and international agreements
- deter and enforce efforts to eliminate fishing using large drift-nets.

#### *3.2.2.6 Search and Rescue Training*

Actual search and rescue (SAR) missions are considered emergency response and are not part of the action. However, preparedness training for crew to perform search and rescue is part of the action.

As part of aircraft training, the USCG would train for an actual SAR mission by dispatching helicopters, usually one at a time (icebreakers often have two helicopters), to first locate a vessel in distress and report its status prior to dispatching a rescue vessel following the procedure that would be followed during an actual SAR mission. During transit between the icebreaker and the training location, helicopters will fly at an altitude of 1,500 ft or more. During SAR training, because crews are expected to train for actual emergencies, helicopters would conduct search training below 300 ft (higher if training to look for larger vessels) and train for hoisting people from boats, which requires helicopters operate at or below 50 ft. For this reason, SAR training would not be done in protected areas such as preserves and sanctuaries, or over haul out areas, rookeries, designated critical habitat, or proposed critical habitat.

The USCG would also train in how to transport people to safety and in damage control (e.g., plugging holes, patching pipes, or delivering supplies to aid in repair or control damage incurred by a vessel in distress). In addition to the icebreaker, other support boats may be employed during an SAR mission so training would include the use of other vessels. Support boats could travel at speeds up to 30 knots though this speed would not be sustained throughout the training activity.

SAR training is expected to occur once per year in the Arctic operation area and once per year in the Antarctic operation area. Training on the icebreaker would occur over four hours, while helicopter training from the icebreaker's flight deck would last 12 hours. During all SAR training, navigation technologies would be used as the vessel would be underway.

### 3.2.2.7 Scientific Support Missions

Historically, most shipboard polar research has been conducted during the late spring through early fall in each of the polar regions. Icebreakers would serve as support vessels assisting scientific missions and would typically be stationary in the ice or in marginal open water during support missions in the Arctic and Antarctic operation areas, although research has mostly been limited to marginal ice zone areas based on historic information on scientific support missions. Because science mission support has been more extensive in the Arctic operation area, the USCG anticipates the majority of science missions during the proposed PSC Program would also take place in the Arctic operation area.

In addition to USCG scientific missions, scientific data requests come from researchers from other federal agencies, such as the USFWS and NMFS, whose researchers are onboard an icebreaker or associated aircraft. If the new icebreakers assist with scientific mission support, the USCG anticipates support activities would be authorized under the researcher's project-specific research permit/authorization. During all science missions, navigation technologies would be used when the vessel is underway.

An Acoustic Doppler Current Profiler (ADCP) is an instrument used by researchers to measure how fast water is moving across an entire water column. An ADCP would be hull-mounted, towed near the surface, or attached to a mooring that also has passive scientific sensors. The ADCP measures water currents with sound, using the Doppler Effect. New icebreakers would be modulated for an ADCP but may not have one onboard because the instrument's purpose is for research and not for USCG operations. The use of an ADCP and other research activities would be analyzed as part of the ESA section 7 consultation required for research permits. Therefore, scientific/survey support missions are not included in this consultation.

### 3.2.2.8 Autonomous Underwater Vehicle Deployment

AUV deployment would occur in the Arctic operation area twice per patrol. An icebreaker may deploy AUVs to assist missions such as observing the ice conditions from under the ice or to patrol living marine resource zones. Operations would likely take place in ice-covered seas; therefore, AUVs would most likely be deployed over the side of the icebreaker after ice clearing has occurred. AUV deployments would last a maximum of 24 hours, after which the device would be retrieved and brought back onboard the icebreaker. The icebreaker would be stationary or transiting at speeds up to three knots during deployment of an AUV. Deployed AUVs can transit at speeds of up to 10 knots. All systems on the AUV would be passive and would not emit any sound into the water.

### 3.2.2.9 Training

<u>Diver Training</u>

Diver training would occur once every other deployment while the icebreaker is stationary. If a dive team is aboard an icebreaker for a patrol, the team would be expected to train once per month during vessel transit and then twice while the vessel is operating in the ice. Diver training activities would last up to two hours and occur only while the icebreaker is stationary. Diver training would support a variety of icebreaker maintenance, repair, and protective measures including ship husbandry, hull inspections, cofferdam placement and removal, plugging and patching, zinc placement and removal, and hull protection sweeps. During training, divers would be expected to take pictures of the propeller gear.

Based on historical and existing locations for diver operations and training, possible locations for diver operations and training on the new icebreakers include Honolulu, Hawaii; Sydney, Australia; McMurdo Station, Antarctica; and Seattle, Washington. Specific locations for diver training in the Arctic operation area are unknown at this time. In the Antarctic operation area, almost all diver activities would occur at the pier at McMurdo Station, although it is possible for training to occur in the ice. Locations close to shore are preferred for diver training. Diver training is always supported by a small boat.

Gunnery Training

Gunnery training would occur at least 12 nm from shore, likely twice per year. The preferred location of this training is in the open ocean, likely in the Pacific Northwest operation area and potentially in an established U.S. Navy range. Gunnery training in the Bering Sea would be rare and is unlikely to occur due to prevailing weather conditions in this part of the Arctic operation area. During gunnery training, an icebreaker would fire inert (i.e., non-explosive) small caliber, 0.50 caliber rounds. A PSC is expected to have four gun mounts. Each mount would fire between 50 and 250 rounds during training exercises. Because gunnery training is expected to occur twice per year, there would be a maximum of 500 small caliber rounds expended annually as a result of this training. Rounds may be fired at a “killer tomato” target, a 10 foot (ft; 3 meter [m]) diameter inflatable red balloon, which would be dropped in the water and kept stationary. Each training would take over an hour, but the actual firing of gun rounds would take approximately 30 minutes. During training, the icebreaker would be transiting between 6 and 10 knots. The USCG intends to retrieve targets used during gunnery training but some targets are not retrieved if they are a mile or more from the icebreaker and sink before the vessel arrives to retrieve them.

An icebreaker would also carry MK-38 standard system rounds, which are high explosive rounds. MK-38 standard system rounds are for use only during emergencies and not during training. Therefore, MK-38 system rounds are not considered in the effects analysis for this consultation.

Marine Environmental Response Training

In addition to classroom and practical training onshore, oil spill training field exercises may occur in the nearshore in the Alaskan port of Barrow/Utqiagvik or near Norton Sound near Nome, Alaska in the Arctic operation area and in the Pacific Northwest operation area. Training will occur twice per year. Recovery gear for a marine environmental response also needs to be tested annually. Gear testing and personnel training would involve deploying a floating U-shaped boom on the water's surface. During equipment training, the boom would be deployed into the water and an attached pump may pump seawater into the icebreaker to test the pump's functionality. Marine environmental response training would involve the use of a small support boat that would either be stationary or transiting at speed up to 3 knots. The icebreaker would be stationary during training. The in-water part of the training and equipment testing would occur over a three to five-hour period.

Actual emergency response is not included in the action and it is likely that individual emergency consultations will be required for each event. Therefore, emergency response activities other than training are not considered in the effects analysis for this consultation.

#### *3.2.2.10 Fueling Underway*

Each new icebreaker would have the capability to refuel alongside another vessel, potential occurring once every five years. Fueling would last up to three hours and could occur in the Arctic and Antarctic operation areas. The icebreaker would receive one or more fuel lines from another vessel (most likely an oil tanker) that is not underway to be connected. The icebreaker would also be stationary. While refueling, crew fasten fuel lines to the vessel's fuel pipes and closely monitor the transfer firsthand as fuel passes through an icebreaker’s fuel system into the tanks. The crew would constantly survey the fuel transfer and have preventative and reactive safety plans in place and spill kits on hand to respond should a fuel spill occur. In the Antarctic operation area, fuel can be pumped from the icebreaker to an established location at Marble Point. In this event, the icebreaker would also be stationary and connected to fuel lines at Marble Point.

### 3.2.3 **Aircraft Operations**

The new icebreakers will have a flight deck with the ability to launch, recovery, hangar, and maintain manned and unmanned aircraft. Helicopters supporting an icebreaker would either fly from shore to the icebreaker or from the icebreaker to shore, though some flights could be expected to depart and then return to an icebreaker without heading to shore. Typically, aircraft operations would occur closer to shore because they are departing from an established Forward Operating Location (FOL) in the Arctic operation area or from an icebreaker to shore in the Antarctic operation area. The frequency of different aircraft operations and the expected duration are listed in Table 2.

Aircraft operations associated with emergency response are not included in this consultation. The overarching consideration for all flight operations, particularly those conducted in the remote Arctic and Antarctic operation areas, is flight safety, based upon the judgement and direction of the aircraft commander. All USCG aircraft operations are conducted by regularly evaluating risk versus gain for the mission assigned and are regulated by USCG Air Operations doctrine.

#### *3.2.3.1 Landing Qualifications*

Daytime landing qualifications would occur approximately twice per patrol in the Arctic operation area and twice per patrol in the Antarctic operation area. Daytime landing qualifications would involve approximately 15 helicopter takeoffs and landings from an icebreaker's flight deck. Deck landing qualifications would be conducted every month when a vessel is in transit, as part of patrols. Qualifications would occur over four hours. Approximately 25 percent of landing qualifications are expected to occur at night. Other qualification training received by helicopter pilots and crew prior to deployment are not included in the action.

#### *3.2.3.2 Reconnaissance*

Helicopters will conduct reconnaissance flights to detect open water leads in the ice and communicate this information to other assets in the area (an open water lead is an area where an icebreaker can more easily transit). The primary aircraft expected to be used for ice reconnaissance is the MH-60 Jayhawk helicopter; however, the USCG may also use UASs for ice reconnaissance. Flight altitudes could range between 400 to 1,500 ft (122 to 457 m). Helicopters are typically flown at 1,500 ft (457 m) for ice reconnaissance if weather conditions allow. Ice reconnaissance would occur over two hours and would be conducted twice per patrol in the Arctic and Antarctic operation areas.

#### *3.2.3.3 Vertical Replenishments and Mission Support*

Vertical replenishment and mission support would occur twice during a patrol in the Arctic operation area and one per patrol in the Antarctic operation area. Arctic support activities would most likely be out of Barrow/Utqiagvik, Alaska, and Antarctic support activities would occur out of McMurdo Station. During vertical replenishment and mission support, helicopters (generally staged on land at an established FOL) would deliver supplies to/from the icebreaker. This requires 8 hours of flight time and 8 hours on the flight deck of the icebreaker, for a total of 16 hours to complete a replenishment. During verticial replenishments, the helicopter is carrying a sling load under the helicopter, which requires that the helicopter fly at altitudes between 500 to 1,000 ft and altitude and heading changes are minimized to prevent oscillations of the load. Unless the geographic location where vertical replenishment is needed overlaps with protected areas such as preserves and sanctuaries, or over haul out areas, rookeries, designated critical habitat, or proposed critical habitat, or there is an aviation or navigation safety concern, helicopters will avoid flying over these areas during vertical replenishments. During vertical replenishment, the icebreaker would continue normal operations while crew involved in the safe landing and recovery of the helicopter (and supplies) complete this task.

#### *3.2.3.4 Community Outreach and Passenger Transfer*

In the Arctic operation area, community outreach operations would occur twice per patrol. During transfers and community outreach from the icebreaker, helicopters would transport passengers (crew) and scientists and their gear on and off an icebreaker. These transfers would occur twice per patrol and would take place over two hours. This includes 4 round-trips (of 30 minutes each). The icebreaker would continue normal operations while crew involved in the safe landing and recovery of the helicopter and passengers complete this task.

In the Antarctic operation area, passenger transfers would occur four times per patrol. The timing of the transfers would be the same as in the Arctic operation area (i.e., 4 round trips of 30 minutes each over two hours). No community outreach operations would occur in the Antarctic operation area.

#### 3.2.4 Marine Mammal Protection Act Authorization of USCG Polar Security Cutter Program Activities

Rulemaking under the MMPA by NMFS Permits and Conservation Division would establish a framework under the authority of the MMPA (16 USC §1361 et seq.) to allow for the authorization of take of marine mammals incidental to the operation of the new icebreakers in the action area, including the Arctic, Antarctic, and Pacific Northwest operation areas. It is important to note that, if a Letter of Authorization is required because of the multi-year nature of the action and the potential impacts to marine mammals as a result of the action, the MMPA rule will be valid for and will authorize activities related to icebreaker operations only over a five-year period, while this Opinion is analyzing a 40-year time period for the USCG PSC Program. During rulemaking, NMFS Permits and Conservation Division may propose mitigation measures to minimize adverse effects to marine mammals. Some of these measures are likely to overlap with the PDCs (Section 3.3.1) developed to avoid and minimize the potential impacts of the action on ESA-listed species and their designated and proposed critical habitat. If additional measures are required by NMFS, these will be included in the step-down consultation that will be conducted for the rulemaking.

### 3.3 Programmatic Consultation Requirements and Procedures

This section details the non-discretionary PDCs that describe aspects of the action required for activities implemented under the USCG PSC Program to avoid or minimize adverse effects on ESA-listed species and designated or proposed critical habitat. The section also describes the procedures for streamlined project-specific review and for step-down consultations. Finally, the section details the periodic comprehensive review procedures for the program.

The following additional elements of programmatic consultations are covered in later sections of the Opinion:

- Description of the manner in which activities to be implemented under the programmatic consultation may affect listed species and critical habitat, and evaluation of expected level of effects from covered activities (Sections 6.1, 8.3, and 10).
- Process for the evaluation of the aggregate or net additive effects of all activities expected to be implemented under the programmatic consultation (Section 8).
- Procedures for tracking and monitoring projects and validating effects predictions, in addition to those contained in this section of the Opinion, are also found in the Incidental Take Statement, including its RPMs and associated Terms and Conditions (Section 12).

The proposed programmatic action includes specific activities that are (1) not likely to adversely affect ESA-listed species and their designated or proposed critical habitat with implementation of applicable PDCs, and (2) are likely to adversely affect ESA-listed species and their designated or proposed critical habitat, even with implementation of PDCs. While some activities have ESA section 7 determinations made under this programmatic Opinion, there are others that are likely to adversely affect ESA-listed species and their designated or proposed critical habitat that will require a step-down consultation. For activities that may result in take of ESA-listed species, additional RPMs to reduce or minimize the effect of the take may be developed as part of the step-down consultation. Although some PDCs and RPMs appear similar, the implementing Terms and Conditions of the RPMs provide specific, non-discretionary requirements that the action agency must follow.

### 3.3.1 Project Design Criteria

The Marine Protected Species Program for the Gulf of Alaska, Bering Sea/Aleutian Islands, and Arctic (Coast Guard District 17 Instruction 16214.2A; USCG 2011) outlines procedures for avoiding marine mammals and protected species; reporting whale and protected species sightings, strandings, and injuries; and enforcing the MMPA and ESA. The Vessel Environmental Manual (Coast Guard Command Instruction M16455.1) describes measures for protection of marine wildlife applicable to all waterborne USCG assets. The Coast Guard Air Operations Manual M3710.1G prescribes measures for protection of wildlife applicable to all USCG air assets. The Coast Guard Approach, Vessel Speed and Strike Response Guidance (COMPACAREA R142308Z DEC 11) prescribes measures for the protection of whales during routine vessel operations. The Maritime Law Enforcement Manual (Coast Guard Command Instruction 16247.1) requires that during all maritime law enforcement activities personnel shall seek to avoid collision with a whale. Additionally, the 2017 Operation Arctic Shield Operations Plan, Annex L, Environmental Considerations, guides USCG participation in activities in the Arctic.

PDCs have been identified to limit environmental effects of patrols and associated vessel and aircraft operations described in Section 3.1, as well as the impacts of vessel transit to and from operation areas, described in Section 4. PDCs have also been included for icebreaking, bollard condition testing, and vessel escort and towing activities but, because some or all of these activities will require step-down consultations, additional PDCs may be developed as part of these step-down consultations. The PDCs included in this Opinion are taken from the SOPs and best management practices (BMPs) the USCG implements based on the manuals and guidance documents described above (USCG 2017) and additional requirements NMFS believes are necessary to avoid and minimize potential adverse effects of the action on ESA-listed species and designated critical habitat based on consultations involving vessel and aircraft operations, military training and testing, and oil spill response. These PDCs, when applied to in-water activities associated with the operation of the new icebreakers, minimize the negative effects to ESA-listed species and designated critical habitat.

General PDCs applicable to all activities addressed in this consultation:

1. In accordance with Chapter 11 of the Vessel Environmental Manual, all Commanding Officers and Officers in Charge must plan and act to protect ESA-listed species and designated critical habitat during operations and planning, including through selection of navigation and flight routes that avoid designated critical habitat and areas where ESA-listed species are known to concentrate.
2. Marine mammal and sea turtle avoidance measures are prescribed (see #9 below), including requiring that vessel crew be especially alert for activity, and proceed with caution, in areas of known migration routes or high animal density, including areas with concentrations of floating vegetation where animals may be feeding, and that vessels do not approach marine mammals or sea turtles head-on during non-emergency maneuvering when navigationally safe to do so.
3. In accordance with Chapter 10 of the Vessel Environmental Manual, ballasting and de-ballasting shall be conducted in a manner to minimize the introduction of non-native species and reduce their potential impact on natural resources in areas where waters are discharged. Vessels shall control all ballasting and de-ballasting evolutions as indicated below:
    a. Each transfer of ballast water shall be recorded in the Machinery Log noting ship's location, water depth, tanks involved, and amount of ballast taken aboard or discharged.
    b. To the maximum extent practicable, taking on ballast water under the following conditions shall be avoided:
        i. In areas known ot have infestations or populations of harmful organisms or pathogens (e.g., harmful algal blooms)
        ii. In areas near sewage outfalls
        iii. In areas near dredging operations
        iv. In areas where tidal flushing is known to be poor at times or at times when tidal flow is known to cause more turbidity in water
        v. In darkness where bottom-dwelling organisms may rise up in the water column
        vi. In areas where propellers may stir up the sediment.
4. Ballasting and/or de-ballasting within 12 nm from land shall be avoided. Ballast water taken on board from a location more than 200 nm from any shore and in water of a depth greater than 200 m may be discharged without restriction.

5. Ballast water taken on board within 200 nm from any shore or in water less than 200 m deep, must be managed in accordance with the applicable Damage Control Book and the stepwise protocol below:

    a. Exchange ballast water in an area greater than 200 nm from any shore and in water more than 200 m deep with an efficiency of 95% or more of the original volume. Do not exchange ballast in ballasted fuel tanks.

    b. If unable to meet requirements in (a), then exchange ballast water in area greater than 200 nm from any shore and in water more than 200 m deep, passing two complete tank volumes through. Do not exchange ballast in ballasted fuel tanks.

    c. If unable to meet requirements in (b), then exchange ballast water in area greater than 200 nm from any shore passing two complete tank volumes through. Do not exchange ballast in ballasted fuel tanks.

    d. If unable to meet requirements in (c), then retain ballast water as long as safely practicable or conduct flushing as far from shore as possible.

    e. If unable to meet requirements in (d), then discharge ballast water to an approved receiving facility. Vessel safety and the absence of other alternatives are the only considerations that may be applied to this discharge alternative.

6. In all cases, the minimum distance for de-ballasting shall be 12 nm from land.

7. In the Arctic operation area, any ballast water taken on board would likely be released (ballast tanks cycled) in the Bering Sea prior to entering any port (e.g., Dutch Harbor, Nome) for refueling. If it is suspected that invasive species are in this ballast water, efforts must be made to release these species in the open ocean.

8. Vessel operators shall use caution, be alert, maintain a vigilant lookout and reduce speeds, as appropriate, to avoid collisions with marine mammals and sea turtles and to avoid collisions with benthic habitats during the course of normal operations.

9. During non-emergency vessel operations, including law enforcement activities, when marine mammals or sea turtles are sighted or known to be in the immediate vicinity at the time of operations (such as if helicopters sight animals along the vessel's intended course), operators shall employ all possible precautions to avoid interactions or collisions with animals when navigationally safe to do so and, in the case of law enforcement activities, when practical to do so. These precautions should include one or more of the following:

    a. Reducing speed (see #10)

    b. Posting additional dedicated lookouts to assist in monitoring the location of sea turtles and/or marine mammals

c. Avoiding sudden changes in speed and direction, or if a swimming marine mammal or sea turtle is spotted, attempting to parallel the course and speed of the animal so as to avoid crossing its path

d. Avoiding approach of sighted animals head-on or from directly behind.

e. When whales are sighted, maintain a distance of 200 yards (yd; 183 m) or greater between the whale and the vessel and a distance of 500 yd (457 m) or greater for right whales, provided it is safe to do so in ice free waters. In the Bering Sea, and along the east coast of the continental U.S., a whale should be treated as a right whale unless the whale is positively identified as another whale species.

f. When sea turtles or dolphins are sighted, attempt to maintain a distance of 50 yd (46 m) or greater between the animal and the vessel wherever possible.

10. Reductions in vessel speed to 10 knots or less shall be considered when a whale is sighted within 5 nm of the intended vessel track. Vessels shall use navigationally prudent courses to avoid striking the whale and, if necessary, reduce speed to bare steerageway or come to a stop.

11. Crewmembers shall be trained in marine mammal and sea turtle identification and will alert the Command of the presence of these animals and initiate the adaptive mitigation responses identified in #9 and 10 above.

12. At least one trained crewmember shall look for marine mammals and sea turtles during all vessel operations associated with the activities described in this Opinion. If a marine mammal or sea turtle is spotted, the vessel shall avoid them by changing course and/or taking the measures identified in #9 above unless there is a threat to vessel safety.

13. Small vessels shall also have a trained crew member to look for marine mammals during vessel operations associated with the activities described in this Opinion. If a marine mammal or sea turtle is spotted, the vessel shall avoid them by changing course and/or taking the measures identified in #9 above.

14. At least one trained crewmember shall serve as an observer to look for marine mammals and sea turtles during all aircraft operations associated with the activities described in this Opinion. If a marine mammal or sea turtle is spotted, the aircraft shall minimize disturbance of sea turtles and avoid the marine mammal by changing course. For unmanned aircraft, a trained crewmember on the vessel will be on the lookout for listed species.

15. Unless a vessel or aircraft's mission involves specifically investigating a listed species under NMFS jurisdiction or there is an aviation or navigation safety issue during transit or flight, the vessel or aircraft shall plan its passage to avoid any known sanctuaries, feeding grounds, or other biologically important areas.

16. The USCG shall coordinate with NMFS, USFWS, and local sources in the Arctic to learn of confirmed haulout locations and communicate them to all field units in the Arctic operating environment as part of the requirement not to discharge sewage black water within 3 nm of known or reported marine mammals to the extent operating constraints permit.

17. The USCG shall document sightings of ESA-listed marine mammals and sea turtles during vessel transit whenever course changes or other measures are taken to avoid or minimize interactions with the animals in the daily Operational Summary (OPSUM). Information shall include, at a minimum: date and time of the sighting that required action be taken to avoid or minimize vessel interaction with an animal, the species observed (if animals can be determined to species; if not, the type of animal [i.e., whale, sea turtle, pinniped]), number of animals sighted, approximate geographic coordinates, and action taken to avoid or minimize interactions between the vessel and the animal(s). Additional information, including photographs, will be collected as needed. Sightings listed in the OPSUMs and any supplemental information, such as photographs, will be consolidated and submitted to NMFS Office of Protected Resources Interagency Cooperation Division as part of the annual reporting requirements under this programmatic.

18. The USCG shall document sightings of ESA-listed marine mammals within 200 yards and sea turtles within 50 yards of a vessel during vessel operations in the Pacific Northwest, Arctic, and Antarctic operations areas including towing and escort, fueling underway, AUV use, gunnery training, icebreaking, ice reconnaissance, and environmental response and SAR training in the daily OPSUM. The information shall include: date and time for each sighting event; species observed, number of animals per sighting, number of animals that are adults/juveniles/calves/pups, behavior of the animals in sighting event, and geographic coordinates for the observed animals; information regarding sea state, weather conditions, visibility, lighting conditions, and percentage of ice cover (if applicable); and activity in which vessel(s) is(are) engaged and any actions taken to avoid or minimize interactions with the animals. Additional information, including photographs, will be collected as needed. Sightings listed in the OPSUMs and any supplemental information, such as photographs, will be consolidated and submitted to NMFS Office of Protected Resources Interagency Cooperation Division as part of the annual reporting requirements under this programmatic.

19. Units shall identify a person onboard the vessel who will have the primary responsibility for photographing, videotaping, and recording marine mammal and sea turtle sightings in accordance with requirements. This will be a Collateral Duty Assignment for a crew member.

20. Any collision with and/or injury to a marine mammal or sea turtle shall be reported immediately to the appropriate NMFS office and local authorized stranding/rescue

response organizations based on where the incident occurred (see https://www.fisheries.noaa.gov/report for regional contact information for reporting).

21. When planning transit routes from one operation area to another and/or from the vessel homeport to the Antarctic operation area, ports in which docking facilities are available to support the mooring of the icebreaker are preferred. If ports that do not have docking facilities for the icebreaker are used, then anchorage areas that do not contain ESA-listed species such as corals or benthic habitats that support ESA-listed species' feeding, refuge, and reproduction are preferred.
22. Impacts to ESA-listed corals associated with vessel operation, including anchoring, are prohibited unless a step-down consultation has been completed to address these effects or an emergency consultation is initiated under the ESA section 7 emergency consultation procedures, depending on the specific circumstances.

PDCs applicable to towing:

1. All tow lines and cables used for towing a vessel or ice pier shall be kept taut to the greatest extent possible and will be monitored for fraying or other signs of potential failure that could result in entanglement of ESA-listed species.
2. A trained crew member will search for marine mammals along the transit route used for towing to minimize potential collisions with animals and the icebreaker and/or the vessel or ice pier being towed. The lookout shall inform the captain immediately upon sighting a marine mammal in order for the captain to determine whether changes to vessel speed are required.
3. For vessels being towed to a pier or other mooring, the icebreaker shall bring the vessel as close as is safe such that lines can be passed to crew where the vessel will moor from the icebreaker and/or vessel being towed or using smaller vessels to ferry the lines from the vessel to the mooring point to minimize the potential for slack in the lines that could result in entanglement of ESA-listed species.
4. Tow lines shall be collected as soon as is safely possible to minimize dragging of lines in the water that may damage habitat used by ESA-listed species or present an entanglement hazard.

PDCs applicable to AUV use:

1. AUVs shall not be deployed if marine mammals are in the immediate area where deployment is planned. Operators will wait to deploy AUVs until marine mammals have been confirmed to have departed the area of their own volition where AUVs will operate, or have not been resighted for 15 minutes for small dolphins and pinnipeds or 30 minutes for large whales.
2. During AUV operation, a dedicated lookout shall monitor for signs the craft is disturbing marine mammals based on changes in behavior of animals in the water (such as

avoidance, fleeing, ceasing feeding, or other ) or on the ice (such as alert behavior or flushing into the water) in areas where the craft is operating.

3. If behavioral changes are observed, the craft shall either be retrieved or changes will be made to its transit route to avoid marine mammals in the area where it is operating.

PDCs applicable to fueling underway:

1. The new icebreakers and any tankers or other vessels providing fuel shall be equipped with spill response equipment and will end fueling operations immediately upon detection of leaks or spills and clean up any fuel as quickly as possible to minimize any potential transfer of fuel to marine waters.
2. Should a spill occur during fueling underway, the USCG shall engage in ESA section 7 emergency consultation for the response activities associated with spill cleanup with NMFS and USFWS as necessary.
3. Fueling underway shall be conducted when vessels are stationary or moving at very slow speeds.
4. No fueling underway shall take place during inclement weather or in areas with rough seas to minimize the potential for accidental spills.

PDCs applicable to dive team operations and/or training involving ship husbandry and plugging and patching, and cofferdam placement and removal:

1. Underwater ship husbandry and plugging and patching shall be conducted pierside to the extent possible to minimize the introduction of chemical compounds or fouling species into waters of the operation areas.
2. All underwater ship husbandry shall be conducted in keeping with the requirements of the Uniform National Discharge Standards (UNDS) rules for vessels of the Armed Forces –under the authority of the Clean Water Act, which will amend 40 CFR 1700 to establish performance standards for discharges that are incidental to the normal operation of vessels of the Armed Forces, which includes USCG vessels, once promulgated (anticipated date of issuance of final rule is April 2019).
3. When temporary cofferdams are needed to allow work on through-hull fittings, these temporary barriers shall be secured to the hull by divers and removed as soon as work is complete to minimize the potential for marine debris from cofferdam material falling off the hull and into the water.

PDCs applicable to gunnery training in the Pacific Northwest operation area:

1. A mitigation zone with a radius of 200 yd (183 m) shall be established for small-caliber gunnery exercises using non-explosive practice munitions with a surface target. Vessel personnel will observe the mitigation zone from the firing position.

2. The exercise shall not commence if concentrations of floating vegetation (kelp patties) are observed within the mitigation zone.
3. Firing shall cease if a marine mammal or sea turtle is sighted within or approaching the mitigation zone. Firing (aimed away from the animal) will recommence if the animal is observed exiting the mitigation zone, the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a firing ship, or the intended target location has been repositioned more than 400 yd (370 m) away from the location of the last sighting and in a direction opposite the animal's path or direction in which it was moving.
4. Plastic "killer tomato" and other targets used during training shall be retrieved from the water to the extent possible to minimize the potential for these to become marine debris and entangle marine mammals and other ESA-listed species or be ingested by animals, potentially leading to health consequences. Targets with a floating line will be preferentially used to allow for for easier recovery. If targets are left in the water,, over the course of training exercises in the operation area observers will look for signs of entanglement of ESA-listed species and will follow appropriate reporting procedures, as necessary, to assist entangled animals (see https://www.fisheries.noaa.gov/insight/entanglement-marine-life-risks-and-response#what-should-i-do-if-i-see-an-entangled-animal?).

PDCs applicable to environmental response training:

1. If boom or other spill control tools or technology will be deployed during training, deployment shall be done in a way that avoids impacts to habitat used by ESA-listed species.
2. Booms and other underwater equipment shall be continuously monitored during deployment to ensure no marine mammals or sea turtles are entrapped within the equipment and during the training activity to ensure no marine mammals become entangled. Monitoring will be done by a dedicated, trained crew member.
3. Sightings of marine mammals before, during, and after training activities shall be reported to NMFS to inform future consultations, including emergency consultations for similar activities. Observations of marine mammals before activities shall include things like: species, predominant behavior (e.g., resting, traveling), group size, age class, and direction of travel. During the activities, observers can determine whether animals changed their direction of travel in relation to the activity or changed behavior. After activity has ceased, observers can determine whether animals return to their pre-activity behaviors. (Note that the reporting requirements will also be determined based on the MMPA authorization issued for the icebreaker.)
4. Drills and exercises shall be conducted at least 2 nm from aggregations of pinnipeds or cetaceans to minimize potential disturbance of these animals during training activities.

PDCs applicable to aircraft operation:

1. In accordance with the instruction in the USCG Air Operations Manual, Commanding Officers shall implement SOPs to prevent unnecessary overflight of sensitive environmental habitat areas to include, but not be limited to, designated critical habitat, migratory bird sanctuaries, and marine mammal haul-outs and rookeries. Environmentally sensitive areas will be properly annotated on pilot's charts as required.
2. When it is necessary to fly over sensitive habitat areas (e.g., designated critical habitat, known haulouts and rookeries, pinniped aggregations), an altitude of 2,000 ft (610 m) above ground level shall be maintained (unless a higher altitude is required by regulations at 50 CFR), except in a situation defined by 50 CFR 402.05 as an emergency (i.e., situations involving acts of God, disasters, casualties, national defense or security emergencies) and for reconnaissance. The amount of time spent at low altitudes should be limited to what is necessary to respond to the particular emergency or conduct reconnaissance overflights.
3. Aircraft shall not operate at an altitude lower than 1,500 ft (457 m) within 0.5 miles (mi; 805 m) of marine mammals observed on ice or land. Helicopters may not hover or circle above such areas or within 0.5 mi of such areas. When weather conditions do not allow a 1,500 ft flying altitude, such as during severe storms or when cloud cover is low, aircraft may be operated below the 1,500 ft altitude. However, when aircraft are operated at an altitude below 1,500 ft because of weather conditions, the operator will attempt to avoid areas of known marine mammal concentrations and will take precautions to avoid flying directly over or within 0.5 mi of these areas.
4. UASs shall not operate within a 1,000 ft (305 m) of marine mammals observed on ice or land. When UASs must be operated within 1,000 ft (305 m) of marine mammals due to weather conditions, the operator shall take precautions to avoid flying directly over animals.
5. For passenger transfer, aircraft shall operate at an altitude of at least 1,500 ft (457 m) between the icebreaker and FOL or other land-based point of departure except during take-off and landing except in cases of emergency.
6. During vertical replenishments, aircraft routes shall avoid operation over areas known to be used by or contain concentrations of marine mammals to the maximum extent practicable to minimize disturbance to these animals.

PDCs applicable to icebreaking activities, including for vessel escort and towing and ice condition testing:

1. Operation of vessels during daylight hours is recommended when conducting icebreaking to allow periods without disturbance to wildlife and to improve possibilities of observing marine mammals in order to minimize potential impacts to these animals.

2. For vessel escort and towing, the extraction path with the smallest impact footprint in habitats used by ESA-listed ice seals shall be selected based on the location of the vessel in relation to ice and open water pathways for navigation, as well as safety concerns.

### 3.3.2 Project-Specific Review and Step-Down Consultation Procedures

Because this mixed programmatic consultation is based on general information taken from current operations, as each of the new icebreakers is constructed and commissioned, an icebreaker-specific and activity-specific review must be completed to ensure all of the relevant PDCs are met and determine whether additional PDCs are required for a particular vessel or operations in which the vessel will engage.

A project-specific review as each icebreaker is completed must be submitted to NMFS ESA Interagency Cooperation Division by the USCG. The USCG will certify compliance with the applicable PDCs along with the information described below to NMFS OPR via email (cathy.tortorici@noaa.gov) with a copy sent to the Alaska Regional Office (jon.kurland@noaa.gov) for activities in the Arctic operations area and the West Coast Regional Office (chris.yates@noaa.gov) for activities in the Pacific Northwest operations area. The subject line should include a reference to "FPR-2018-9285, Programmatic Consultation with the USCG for the Construction and Operation of New Icebreakers." The submission will include the following information:

1. Date sent to NMFS: This is the date the email was provided to NMFS
2. Location: This should include the location from which the new icebreaker will transit and the homeport of the new icebreaker, as well as whether vessel testing and some training activities will occur in the Pacific Northwest for the new vessel or require the use of a new area based on the vessel's homeport or other factors. This will enable NMFS to determine whether there may be changes to the action area requiring a step-down consultation.
3. Transit routes: This should include information as to whether the transit routes to be used by the new icebreaker from the shipbuilding facility to its homeport will be the same or different from the general transit routes analyzed in this Opinion. This should also include information as to whether transit routes to be used by the new icebreaker to and from the operation areas in the Arctic and Antarctic will be the same general routes as those analyzed in this Opinion, including transit routes to and from training and testing areas, if they are different from those analyzed in this Opinion. This information will enable NMFS to determine whether there may be changes to the action area that will affect the activity-specific effects analysis and the PDCs and thus determine if reinitiation of consultation is necessary.
4. PDCs met: Answer yes or no as to whether or not all of the applicable PDCs in this document will be met by the proposed operation of the new icebreaker for the activities identified as not requiring further analysis.

5. Project-specific information should also be provided, including details of the dimensions of the new icebreaker, anticipated operational speed and maximum speed capability of the new icebreaker, and any proposed changes to the activities that were analyzed in this Opinion as part of the operation of the new icebreaker or any new activities that will be associated with the operation of the new icebreaker. This information will enable NMFS to determine the potential effects specific to the new icebreaker on ESA resources in the action area and assess the risk to these resources as a result of the operation of the new icebreaker. The information will also enable NMFS to determine whether additional protective measures for avoidance and minimization of effects of operation of a particular new icebreaker are required as part of a step-down consultation.
6. A copy of the MMPA authorization request should be provided.

NMFS Permits and Conservation Division must also submit a project-specific review to the ESA Interagency Cooperation Division each time MMPA authorization is requested. The subject line should include a reference to "FPR-2018-9285, Programmatic Consultation with the USCG for the Construction and Operation of New Icebreakers." The submission will include the following information:

1. Date sent to NMFS: This is the date the email was provided to NMFS.
2. A copy of the MMPA authorization request with details of the acoustic analyses conducted to assess the potential effects of the operation of new icebreakers and associated aircraft operations and other activities on marine mammals. NMFS Permits and Conservation Division will also be required to submit information regarding any proposed rule and required mitigation to minimize adverse effects of the action to marine mammals.

NMFS will assess the information for each new icebreaker as it is constructed and as details of its likely operational activities are developed by the USCG, and as NMFS Permits and Conservation Division drafts a rule or takes other regulatory action to authorize incidental take of marine mammals under the MMPA for icebreaker operations.

NMFS anticipates that step-down consultations may be required for the following activities due to the need for MMPA authorization, the uncertainty regarding the contents of any MMPA rule because of the time lag between this consultation and MMPA authorization and the timing for completion of each new icebreaker, and because of the potential for changes in some of these activities due to a changing climate affecting ice cover:

- icebreaking
- ice condition testing
- vessel escort
- vessel tow
- helicopter operations.

Additionally, as noted above, this Opinion requires that the USCG and NMFS Permits and Conservation Division make project-specific findings for activities they carry out, review, permit or otherwise authorize to determine consistency with this Opinion, including its effects analyses. The review of these findings will determine the need for step-down consultation on an activity and/or vessel-specific basis. These reviews will also be compiled for annual review of this programmatic consultation.

As discussed in Section 3.2, the USCG requested that emergency response activities and scientific research activities not be included in the action analyzed under this Opinion. Therefore, any emergency response activities require individual ESA section 7 consultations using the emergency consultation procedures, including the requirement for formal consultation once a response is completed if take of ESA resources has occurred as a result of the response. Scientific research activities requiring an ESA and/or MMPA authorization also require individual ESA section 7 consultations.

### 3.3.3 Programmatic Review

The USCG and NMFS will conduct an annual programmatic review of the operation of the new icebreakers beginning one year after the first new icebreaker has been delivered and is operating in the Arctic and Antarctic. This review will evaluate, among other things, whether the scope of the operations of the new icebreaker is consistent with the description of the proposed activities; whether the nature and scale of effects predicted continue to be valid; whether the PDCs are being complied with and continue to be appropriate; and whether the project-specific (i.e., new icebreaker) and step-down consultation procedures are being complied with and are effective. To assist in this annual review, the USCG will submit a summary review 30 days prior to the end of the first 12-month period after the first new icebreaker is fully operational and 30 days prior to the close of all subsequent 12-month periods. The USCG will submit a summary of the activities conducted by each new icebreaker; information regarding the PDCs implemented for each activity and their effectiveness in avoiding and minimizing impacts of the program on ESA-listed species and their designated or proposed critical habitat; any issues identified by the trained observer, vessel captain or other crew member in implementing avoidance and minimization measures; copies of sighting logs for marine mammals and sea turtles; and monitoring and reporting of take of ESA-listed species included in an ITS.

# 4 ACTION AREA

*Action area* means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 C.F.R. §402.02).

For this programmatic consultation, the action area includes the operation areas in the Arctic, Antarctic, and U.S. Pacific Northwest, as well as transit routes between the operation areas and the homeport of the new icebreakers. At this time, the homeport is expected to be Seattle, Washington, where the current icebreaker fleet is homeported.

The Arctic operation area (Figure 1) is defined on its southern boundary from the point of intersection of the Maritime Boundary Line and the line of 54 degrees North (°N) latitude, and follows the line of 54°N latitude eastward to a point of intersection at longitude 168 degrees West (°W) and latitude 54°N , then follows a rhumbline in an east/northeast direction to a point of intersection at longitude 160°W and the United States Arctic Research and Policy Act boundary line, which is near Cape Seviavin on the Alaska Peninsula. Sea/surface operations in support of the action, including operation of other USCG assets such as smaller vessels, would likely occur north of 60°N within the EEZ due to the proximity of the icebreaker to those ports where other USCG assets are berthed. Air operations in support of the action would primarily occur within 180 nm of the primary FOL in Kotzebue with some flights also occurring within 180 nm of alternate FOL locations of Barrow/Utqiagvik, Deadhorse/Prudhoe Bay, and Nome, as well as some flights being conducted to support icebreaker operations occurring within 60 nm of the flight deck of the new icebreakers. FOLs are temporary but are located in established USCG bases for sea and air support in the Arctic.

The Antarctic operation area (Figure 2) is defined as all land and waters south of 60 degrees South (°S) latitude. The Antarctic operation area is in the Ross Sea adjacent to McMurdo Station. The Ross Sea is a 1.9 million square mile stretch of ocean off the coast of Antarctica and almost completely within the Ross Sea Marine Protected Area.

The Pacific Northwest operation area (Figure 3) is off the coast of Washington State; offshore of Vancouver Island, British Columbia, Canada; and the Strait of Juan de Fuca, seaward of the Olympic Coast National Marine Sanctuary.

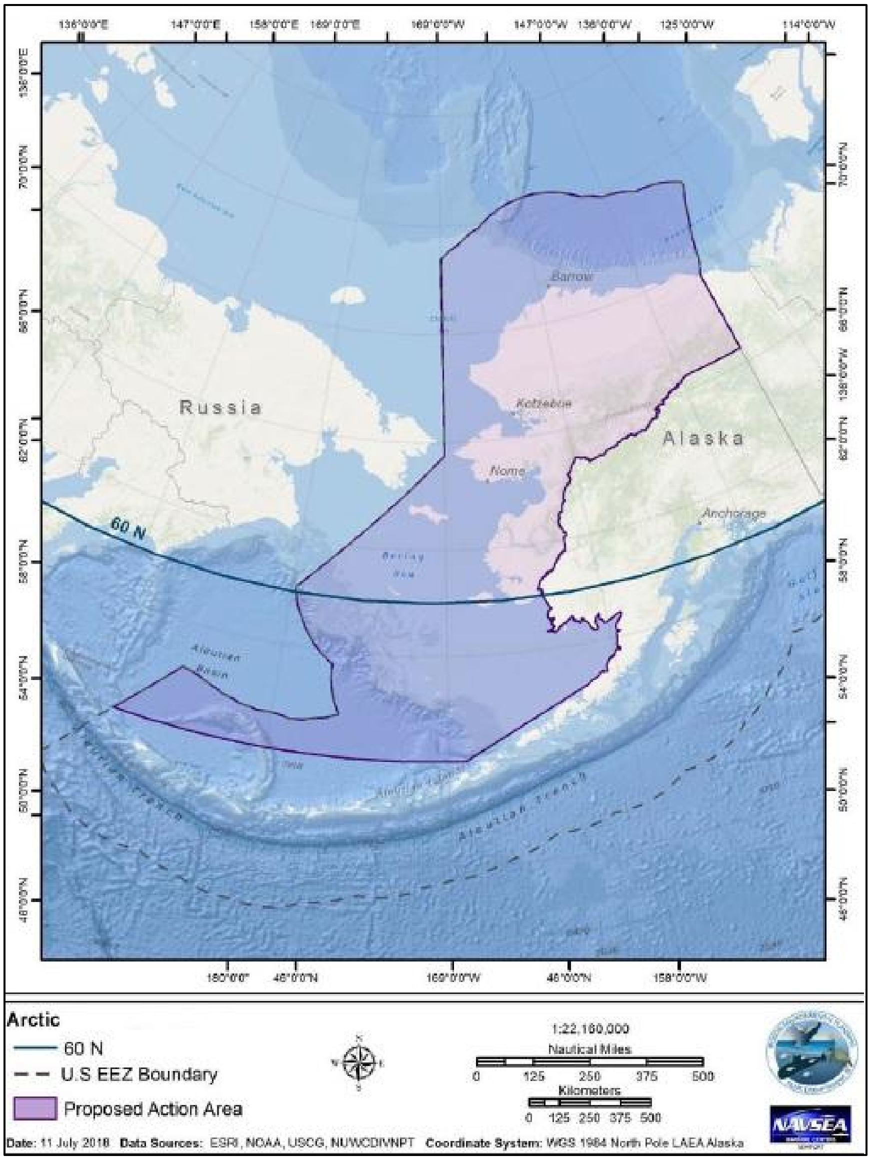


**Figure 1. Arctic Operation Area (based on USCG 2019)**

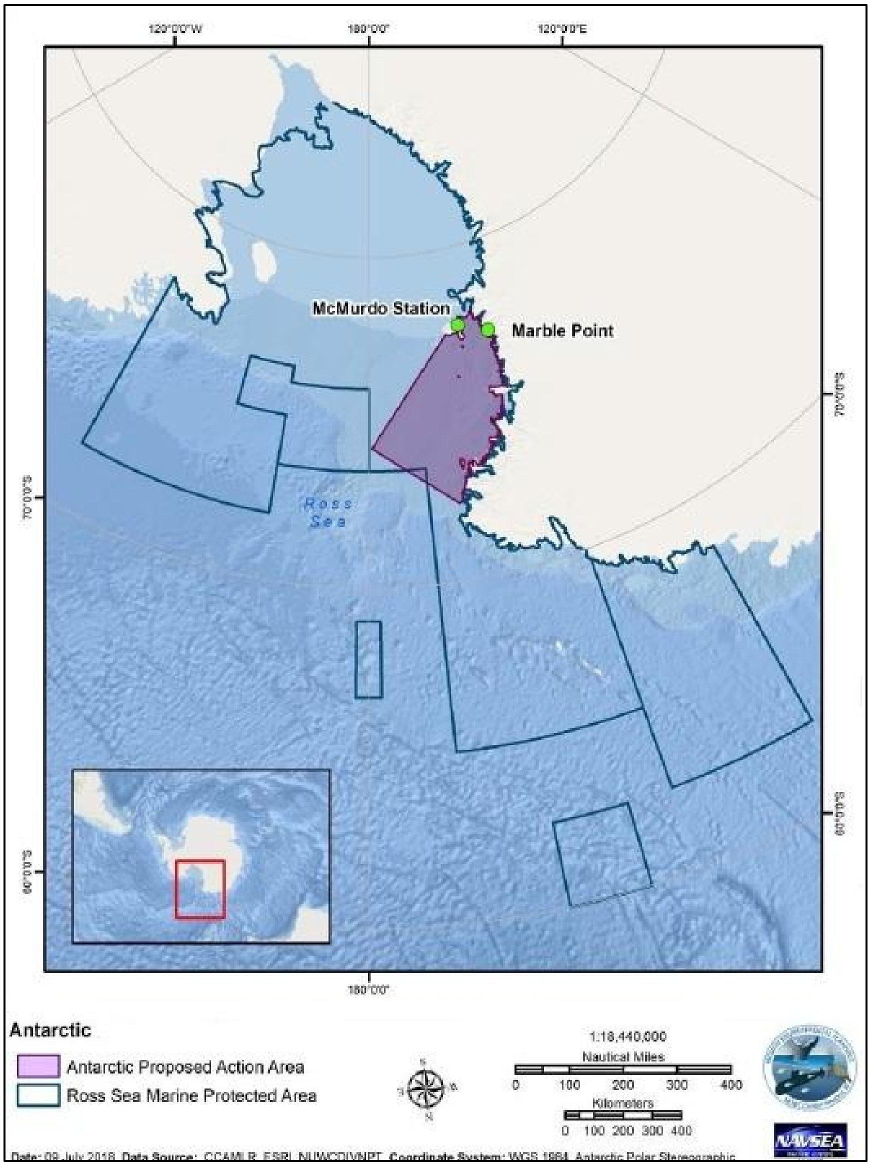


**Figure 2. Antarctic Operation Area (based on USCG 2019)**

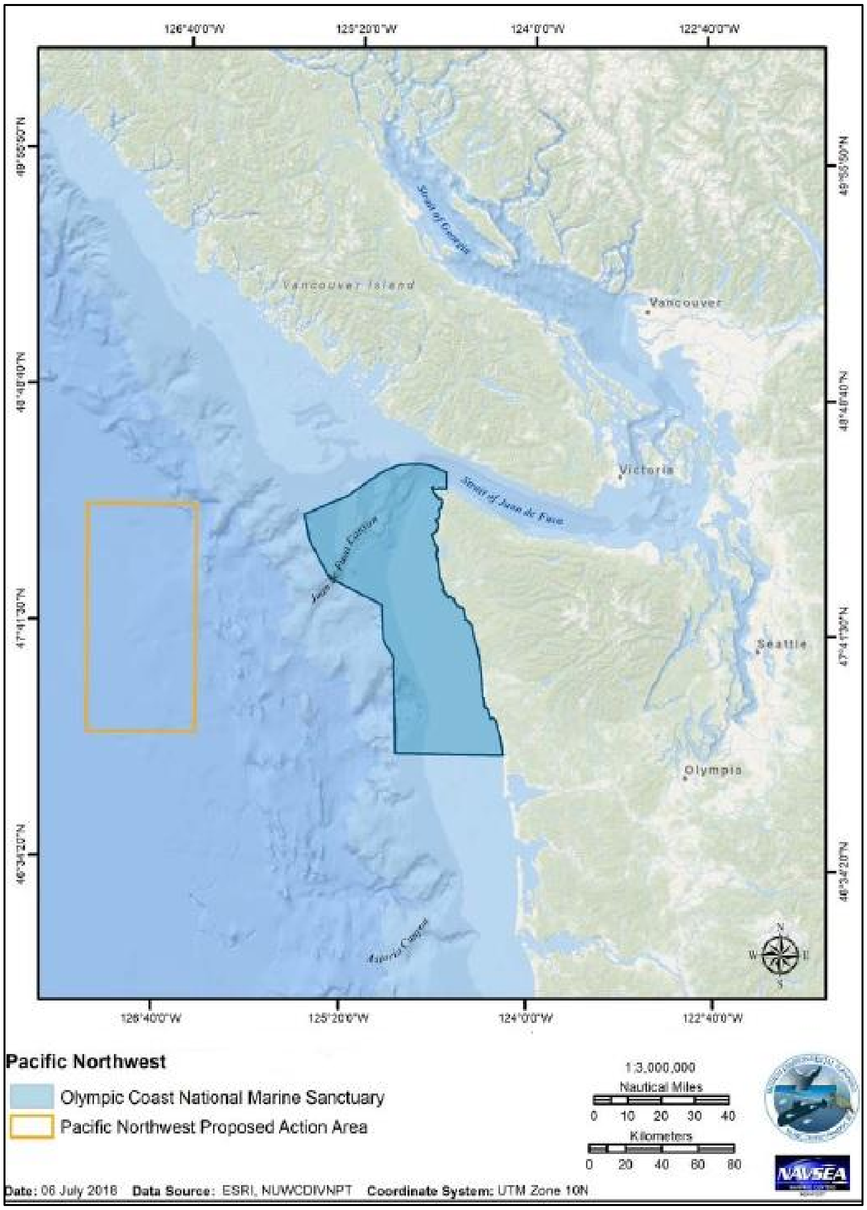


**Figure 3. Pacific Northwest Operation Area (based on USCG 2019)**

The new icebreakers will be transcontinental vessels that will travel worldwide to support the USCG's missions in the Arctic and Antarctic operation areas. A transit route to the Antarctic operation area could begin in Seattle, Washington, transit to Honolulu, Hawaii to Hobart, Australia and then to McMurdo Station, Antarctica. On the return trip, the vessel might transit to Fiji and return to Seattle. Another transit route to the Antarctic operation area could begin in Seattle, Washington, transit along the West Coast of the U.S. then through the Panama Canal, through the Caribbean, across the Atlantic Ocean to the west coast of Africa, south along the African coast and then to Australia and down to Antarctica. In transit to or from the Arctic or Antarctic operation areas, icebreakers may visit ports in Alaska, Greenland, Hawaii, New

Zealand (Christchurch), and Australia (Sydney or Hobart, Tasmania). The main port of call for patrols to and from Antarctica is Honolulu, Hawaii and the transit route through the Pacific Ocean is the more likely one for the new icebreakers to reach the Antarctic operation area. The main port of call to and from the Arctic is Dutch Harbor, Alaska and common stops for supplies associated with patrols to the Arctic are Utqiagvik/Barrow, Dutch Harbor, and Kodiak, Alaska based on cruise reports from existing icebreakers (USCG 2019).

Transit routes between the location where the new vessels are constructed and their expected homeport may also result in effects to ESA-listed species. Although the location or locations of the shipbuilding facility or facilities that will be used during construction of each of the new icebreakers is unknown at this time, the large shipbuilding companies likely to have the capacity to construct the new vessels are located in Louisiana, Mississippi, Florida, Virginia, Texas, Alabama, Maine, Connecticut, and California. Therefore, NMFS has included possible transit routes from the general locations of shipbuilding companies in each of these states to the likely homeport of the new icebreakers in Seattle, Washington. If the location or locations where the new icebreakers are constructed is not one of those considered in this Opinion, the effects of the change in shipbuilding location and any resulting shifts in transit routes ESA resources would be analyzed as part of a tiered consultation under this programmatic Opinion as discussed in Section 3.3.

# 5 POTENTIAL STRESSORS

Stressors are any physical, chemical, or biological agent, environmental condition, external stimulus or event that may induce an adverse response either in an ESA-listed species or its designated critical habitat. The action consists of the construction, commissioning, and operation of up to six icebreakers. Vessel construction and commissioning are not expected to result in stressors that affect ESA resources. Vessel operations, which are the subject of this programmatic consultation, are expected to include vessel testing and training activities in the Pacific Northwest and Arctic regions, icebreaking in the Arctic and Antarctic, passenger and equipment transfers, and vessel transit to and from the main operation areas in the Arctic, Antarctic, and Pacific Northwest. Each of the components of icebreaker operations can create stressors that may affect ESA-listed species and their designated critical habitat. The major categories of stressors are: vessel strike, vessel anchoring, vessel discharges and marine debris including from ship husbandry and training activities, sound from multiple sources (e.g., vessel noise during transit, icebreaking, echosounders, helicopters, gunnery training), icebreaking, and entanglement and entrapment. Vessel grounding can be another stressor associated with the operation of large vessels. Should an icebreaker ground, the USCG will engage in emergency consultation with NMFS. Therefore, vessel grounding is not included in this consultation as a stressor caused by the proposed action.

## 5.1 Vessel Strike

The movement of vessels in waters that also might be occupied by endangered or threatened marine mammals and sea turtles pose collision or ship strike hazards to those species. Ship strikes are known to injure and kill sea turtles (Work et al. 2010). Stranding networks that keep track of sea turtles that wash up dead or injured have consistently recorded vessel propeller strikes as a cause or possible cause of death (Chaloupka et al. 2008).

Vessel strikes are considered a serious and widespread threat to ESA-listed marine mammals (especially large whales). This threat is increasing as commercial shipping lanes cross important breeding and feeding habitats and as whale populations recover and populate new areas or areas where they were previously extirpated (Swingle et al. 1993; Wiley et al. 1995). As vessels become faster and more widespread, an increase in vessel interactions with cetaceans is to be expected. All sizes and types of vessels can hit whales, but most lethal and severe injuries are caused by vessels 80 meters (262.5 feet) or longer (Laist et al. 2001). For whales, studies show that the probability of fatal injuries from vessel strikes increases as vessels operate at speeds above 26 kilometers per hour (14 knots; Laist et al. 2001). Evidence suggests that not all whales killed as a result of vessel strike are detected, particularly in offshore waters, and some detected carcasses are never recovered while those that are recovered may be in advanced stages of decomposition that preclude a definitive cause of death determination (Glass et al. 2010). The vast majority of commercial vessel strike mortalities of cetaceans are likely undetected and unreported and most animals killed by vessel strike likely end up sinking rather than washing up on shore (Cassoff et al. 2011). Kraus et al. (2005) estimated that 17 percent of vessel strikes are actually detected. Therefore, it is likely that the number of documented cetacean mortalities related to vessel strikes is much lower than the actual number of mortalities associated with vessel strikes, especially for less buoyant species such as blue, humpback, and fin whales (Rockwood et al. 2017). Rockwood et al. (2017) modeled vessel strike mortalities of blue, humpback, and fin whales off California using carcass recovery rates of five and 17 percent and conservatively estimated that vessel strike mortality may be as high as 7.8, 2.0, and 2.7 times the recommended limit for blue, humpback, and fin whale stocks in this area, respectively.

There are also reported vessel strikes of seals and sea lions. Since 2000, there have been four reported ship strikes of Steller sea lions, all within the Gulf of Alaska area (https://alaskafisheries.noaa.gov/pr/strandings). Vessel strikes are likely not a threat to ringed seals with the exception of icebreakers, which could crush individuals while they occupy their subnivean lairs in spring (Kelly et al. 2010). Because icebreaking activities are expected to increase in the Arctic and are not constrained by the presence of ice (in other words, icebreakers can move where ice is present unlike other vessels), the likelihood of impacts to ringed seals is expected to increase (Kelly et al. 2010). Vessel traffic along the Northwest Passage and Northern Sea routes converge near the Bering Strait, where bearded seals whelp, nurse, and mate from April to May and molt and migrate from May to June (Cameron et al. 2010).

In general, the probability of a vessel collision and the associated response depends, in part, on the size and speed of the vessel. The majority of vessel strikes of large whales occur when vessels are traveling at speeds greater than approximately 14 knots, with faster vessels, especially large vessels (80 m or greater), being more likely to cause serious injury or death (Conn and Silber 2013; Jensen and Silber 2004; Laist et al. 2001; Vanderlaan and Taggart 2007a). Ship strikes with marine mammals can lead to death by massive trauma, hemorrhaging, broken bones, or propeller wounds (Laist et al. 2001). While massive wounds can be immediately fatal, if injury is more superficial, whales may survive the collisions (Silber et al. 2010).

In the Pacific Northwest, there have been reported ship strikes, including one whale strike by the Navy from June 1994 to 2015 (NMFS 2015b). The strike by a Navy vessel occurred in August 2012 when a guided-missile destroyer struck a whale (believed to be a minke whale) off the coast of Coos Bay, Oregon while transiting to its homeport in San Diego, California. The whale was seen swimming away from the location of the strike. The size of the vessel (approximately 550 ft in length) is similar to the size of the CGC HEALY (420 ft in length), one of the currently operating polar icebreakers. Data from the West Coast Marine Mammal Stranding Network indicate that vessel collisions were the reason for 7 percent of small cetacean strandings, 5 percent of pinniped strandings, and 21 percent of large whale strandings associated with human interactions from 2007 to 2016 (https://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/cetaceans/mm_stranding_10yeardata_q_a_final_2018.pdf). The adult male southern resident killer whale (L98) that was killed in a collision with a tugboat in 2006 off the Pacific coast may have reduced the demographic health of this killer whale population. At population sizes between 75 and 90 individuals, we would expect southern resident killer whales to have higher probabilities of becoming extinct because of demographic stochasticity, demographic heterogeneity (Coulson et al. 2006; Fox 2007) —including stochastic sex determination (Lande et al. 2003) —and the effects of phenomena interacting with environmental variability.

Ship strikes were implicated in the deaths of five blue whales, from 2004-2008 in California (Carretta et al. 2011). During 2004-2008, there were an additional eight injuries of unidentified large whales attributed to ship strikes. Blue whale mortality and injuries attributed to ship strikes in California waters averaged 1.0 per year for 2004-2008. From 2009 to 2019, an additional 10 blue whales were struck with two whales affected in 2009 and 2019, three in 2010, and one in 2016, 2017, and 2018 (NMFS West Coast Marine Mammal Stranding Network [WCMMSN] unpublished data). Blue whales are one of the most frequently killed by vessel strikes along with humpback, gray, and fin whales (Rockwood et al. 2017; WCMMSN, unpublished data). Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma. Studies have shown that blue whales respond to approaching ships in a variety of ways, depending on the behavior of the animals at the time of approach, and speed and direction of the approaching vessel. While feeding, blue whales react less rapidly and with less obvious avoidance behavior than whales that are not feeding (Sears 1983).

In Alaska, the USCG cutter CGC MIDGETT struck a sperm whale in the Gulf of Alaska on June 7, 2017, and the whale died from the impact. On August 21, 2019, the USCG cutter JOHN MCCORMICK was underway at a speed of 16 knots in Frederick Sound (in Southeast Alaska outside the action area) in calm seas with 10 mile visibility when the vessel altered course to avoid contact with a small vessel that was crossing its bow (Vessel incident report 2019). While Frederick Sound is outside the action area, this water body in the Inside Passage is similar to many passes in the Aleutians and may be less restrictive for whales and maneuvering vessels than some passes the icebreakers will move through. Crew had spotted whale spouts several nautical miles distant approximately 15 minutes prior to the cutter experiencing a thud that is suspected to have been a collision with one or more humpback whales, which NMFS believes is supported by video taken by the cutter during the incident. At least two humpback whale carcasses were reported in the vicinity of the vessel strike in the weeks following the strike. There have been other ship strike mortalities of marine mammals, including cetaceans and pinnipeds, in Alaska, mainly in the Gulf of Alaska and Bering Sea (https://alaskafisheries.noaa.gov/pr/strandings).

Ship strikes are the largest single contributor to North Atlantic right whale deaths, accounting for approximately 35 percent of all known mortalities, even though right whales should be able to hear the sound produced by vessels (Ketten 1998; Knowlton and Kraus 2001; Laist et al. 2001; Richardson et al. 1995a). Some information suggests right whales respond only within very close proximity to ships (Nowacek et al. 2004). Various types and sizes of vessels have been involved in ship strikes with large whales, including container/cargo ships/freighters, tankers, steamships, USCG vessels, Navy vessels, cruise ships, ferries, recreational vessels, fishing vessels, whale-watching vessels, and other vessels (Jensen and Silber 2004). Injury is generally caused by the rotating propeller blades, but blunt injury from direct impact with the hull also occurs. There have been 18 reports of North Atlantic right whales being struck by vessels between 1999 and 2005 (Cole et al. 2005; Nelson et al. 2007). Of the 17 reports that NMFS could confirm, right whales were injured in two of the ship strikes and killed in nine (NMFS 2008a).

Vessel strike is a poorly-studied threat to sea turtles, but has the potential to be highly-significant (Work et al. 2010). All sea turtles must surface to breathe and several species are known to bask at the surface for long periods, including loggerhead sea turtles. Although sea turtles can move rapidly, sea turtles apparently are not well able to move out of the way of vessels moving at more than 4 km/hr; most vessels move far faster than this in open water (Hazel et al. 2007; Work et al. 2010). This, combined with the massive level of vessel traffic in the Gulf of Mexico, has the potential to result in frequent injury and mortality to sea turtles in the region (MMS 2007). Hazel et al. (2007) suggested that green sea turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases. If an animal is struck by a vessel, responses can include death, serious injury, and/or minor, non-lethal injuries, with the associated response depending on the size and speed of the vessel, among other factors (Conn and Silber 2013; Jensen and Silber 2004; Laist et al. 2001; Vanderlaan and Taggart 2007a). Turtles were found to flee approximately 60 percent of the time from slow-moving vessels (2.5 mph), but infrequently (22 percent of the time) when vessels were moving at moderate speeds (6.8 mph) and rarely (4 percent of the time) when vessels were moving fast (11.8 mph; Hazel et al. 2007).

The Atlantic Sturgeon Status Review Team (2007) determined Atlantic sturgeon in the Delaware River are at a moderately high risk of extinction because of ship strikes and sturgeon in the James River are at a moderate risk from ship strikes. Out of a total of 28 mortalities reported in the Delaware estuary between 2005 and 2008, 14 resulted from vessel strike (Brown and Murphy 2010). Based on the demersal behavior demonstrated by Atlantic sturgeon, the damage inflicted upon carcasses and the large numbers of deep draft vessels, the authors concluded that interactions with large vessels such as tankers comprised the majority of the vessel strikes. Further, the authors determined that a mortality rate of more than 2.5% of the females within a population could result in population declines. Similarly, in the James River in Virginia, 34 out of a total of 39 Atlantic sturgeon had injuries consistent with vessel strikes (Brown and Murphy 2010; Balazik et al. 2012). The actual number of vessel strikes in both of these river systems in unknown, however, (Balazik et al. 2012) estimated up to 80 sturgeon were killed between 2007 and 2010. In these systems, large ships move upstream from the mouths of the river to ports upstream through narrow shipping channels. The channels are dredged to the approximate depth of the ships, usually leaving less than 6 feet of clearance between the bottom of ships and the benthos of the river. Because of the size of the propellers used on large ships, everything along the bottom is sucked through the propellers. Large sturgeon are most often killed by ship strikes because smaller fish often pass through the propellers without making contact but larger sturgeon get hit (NMFS 2008a). Thus, depending on transit routes, water depths, and habitats used by ESA-listed fish species, ship strikes may pose a threat to larger individuals, particularly in coastal areas with limited water depths.

## 5.2 Vessel Anchoring

Anchoring of large vessels can result in significant damage to the marine bottom due to the size of the anchor and chain, particularly in areas where sea conditions cause the vessel to swing on anchor. Areas containing habitats such as coral reefs and other coralline communities are an example of marine habitat that is particularly susceptible to impacts of vessel anchoring. Toller (2005) reported that approximately 13 percent of the Frederiksted Reef System had been impacted by vessel anchoring due to anchoring by large vessels waiting to use the Frederiksted Pier, and vessel groundings. Several of the ports where icebreakers may stop while in transit, particularly to and from the Antarctic operation areas, are located in areas containing coral habitat, including ESA-listed corals. Other habitats used by ESA-listed species considered in this Opinion are also susceptible to impacts from large vessel anchors and chain such as those used by icebreakers. While the USCG noted that anchoring of icebreakers rarely occurs and, when it does, it is in designated anchorage areas associated with existing ports or off the coast of

Utqiagvik/Barrow because it cannot support docking of the current icebreaker fleet so it is assumed that the new icebreakers would need to anchor at this location. The use of designated anchorage areas in existing ports does not preclude the possibility of damage to benthic habitats. Many anchorage areas were designated based on navigational considerations and not protection of marine habitats. For example, designated anchorage areas associated with the Port of Ponce in Puerto Rico and with the Port of Miami in Florida contain coral habitats.

### 5.3 Vessel Discharges and Marine Debris

Vessels regularly discharge into marine waters as part of normal operations. Discharges include deck runoff, leaching of antifouling products, greywater, bilgewater, and other waste streams. The USCG vessels are subject to UNDS regulations promulgated by the EPA and Department of Defense, which restrict the location of discharges and require controls for some discharges that contain contaminants to minimize their release into marine waters. Discharges from vessels can lead to bioaccumulation of contaminants in the tissues of ESA-listed species either through direct ingestion or through ingestion of contaminated prey. Contaminant loading also occurs as a result of discharges from land-based activities such as industry, commercial enterprises, agriculture, and urban and residential areas. While there are reports of bioaccumulation of metals and other contaminants in the tissue of sea turtles and some marine mammal species, little is known regarding the effects pollutants may have on these animals.

The discharge of debris into the marine environment is a continuing threat to the status of species in the action area, regardless of whether the debris is discharged intentionally or accidentally. Marine debris may originate from a variety of sources, though specific origins of debris are difficult to identify. A 1991 report (GESAMP 1990) indicates that up to 80 percent of marine debris is considered land-based and a worldwide review of marine debris identifies plastic as the primary form (Derraik 2002). Debris can originate from a variety of marine industries including fishing, oil and gas, and shipping. Many of the plastics discharged into the sea can withstand years of saltwater exposure without disintegrating or dissolving. Further, floating materials have been shown to concentrate in ocean gyres and convergence zones where *Sargassum* and consequently juvenile sea turtles are known to occur (Carr 1987).

Marine debris has the potential to impact protected species through ingestion or entanglement (Gregory 2009). Both of these effects could result in reduced feeding, reduced reproductive success, and potential injury, infection, or death. Sperm whale ingestion of marine debris is a concern, particularly because their suspected feeding behavior occurs at or near the ocean bottom (Walker and Coe 1990). All sea turtles are susceptible to ingesting marine debris, though leatherbacks show a marked tendency to ingest plastic, which is presumed as misidentification of jellyfish, a primary food source (Balazs 1985). Ingested debris may block the digestive tract or remain in the stomach for extended periods, thereby reducing the feeding drive, causing ulcerations and injury to the stomach lining, or perhaps even providing a source of toxic chemicals (Laist 1987;1997). Weakened animals are then more susceptible to predators and disease and are also less fit to migrate, breed, or, in the case of turtles, nest successfully

(McCauley and Bjorndal 1999; Katsanevakis 2008). Data from the West Coast Marine Mammal Stranding Network indicate that marine debris was associated with one percent of small cetacean strandings and two percent of pinniped stranding associated with human interactions from 2007 to 2016 (https://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/cetaceans/mm_stranding_10yeardata_q_a_final_2018.pdf).

Some of the activities associated with icebreaker operation have the potential to introduce marine debris into the marine environment. Specifically, gunnery training using "killer tomato" targets as currently carried out leads to marine debris when the targets are left in the water rather than retrieved, posing a threat from entanglement (particularly if lines are attached to the target) and ingestion of target fragments in the Pacific Northwest operations area where training activities are proposed. Whales do become entangled in taught or loose cables such as when whales are lunge feeding on schooling fish that have aggregated in an area where there are cables in the water that were not visible to the whales. Gunnery training exercises using small caliber non-explosive practice munitions could result in expended materials (casings) being encountered by marine mammals or sea turtles. Tow lines may also pose an entanglement hazard to animals such as sea turtles if lines remain slack. The placement of temporary cofferdams on the hull of icebreakers by divers, along with ship husbandry and other maintenance activities, have the potential to introduce marine debris into waters of the action area wherever these activities may occur.

### 5.4 Anthropogenic Sound

The acoustic stressors from the action include underwater acoustic transmissions (radar and sonar for navigation), vessel noise during regular operations and testing activities such as bollard testing, helicopter noise, icebreaking noise, and gunnery noise (see Table 3). Acoustic stressors could affect the ESA-listed fish, sea turtles, and marine mammals in the action area, though exposure will vary based on the geographic range of the animals in relation to icebreaker operations. Animals that are not present in the Pacific Northwest and Arctic operation areas will be exposed to acoustic stressors associated only with navigation equipment and vessel and aircraft operation. Animals present in the operation areas will be exposed to these and other acoustic stressors. Icebreaking, including acoustic impacts, is discussed separately in Section 5.5.

The following information on acoustic stressors is taken from (USCG 2019). Source characteristics, animal presence, animal hearing range, susceptibility to barotrauma, duration of exposure, and impact thresholds for animals from acoustic sources vary and will affect the degree to which animals respond to acoustic stressors. The sex, size, and age of animals may also play a role, as well as the activity in which animals are engaged at the time they are exposed to an acoustic stressor. For instance, if animals are hunting, acoustic sources may mask the sounds used to find prey. Or, acoustic stressors may mask predators or other dangers and increase risk of deleterious effects on an animal. Acoustic stressors may also cause temporary or permanent injury or adverse behavioral responses based on the sound levels, proximity to the sound source, duration of exposure, and sensitivity of an animal.

**Table 3. Sound Source Characteristics of Acoustic Stressors Associated with the Action (from USCG 2019)**

| Source Type | Frequency Range (kHz) | Source Level (dB re: 1μPa @ 1m rms) | Associated Action |
|---|---|---|---|
| Small Vessel | 1 - 7 | 175 | Small boat training, routine patrols |
| Large Vessel | 0.02 - 0.30 | 190 | All sea operations and training |
| Icebreaking | 0.025 – 12.8 | 164-189 | Icebreaking activities |
| Single-beam Echosounder | 3.5 – 1,000<br>(24 – 200)[2] | 200[3] | All sea operations and training, research and development[5] |
| Multi-Beam Echosounder[1] | 180 - 500 | 242 | Icebreaking activities, research and development[5] |
| Helicopter | 0.02 - 5 | In air: 136 dB re: 20μPa | Air support |
| UAS | 0.06 – 0.15 | In air: 80 dB re: 20μPa | Reconnaissance |
| Gunnery | 0.15 – 2.5 (with peak from 0.9 – 1.5) | In air: 139 – 154 dB re: 20μPa at 50 ft (15 m)[4] | Gunnery training |

[1]USCG informed NMFS that multibeam will not be used in regular operations. Research activities using multibeam will require separate authorization under MMPA and ESA.

[2]Typical frequency range for most commercially-available devices

[3]Maximum source level is 227 dB root mean square at 1 m, but the maximum source level is not expected during operations

[4]Based on Luz (1983) and Ylikoski et al. (1995)

[5]Research activities will require separate authorization under MMPA and ESA and are not considered in this consultation.

### 5.4.1 Hearing in Fish, Sea Turtles, and Marine Mammals

*Fish*

All fish have two sensory systems to detect sound in the water: the inner ear, which functions very much like the inner ear in other vertebrates, and the lateral line, which consists of a series of receptors along the fish's body (Popper 2008). The inner ear generally detects relatively higher-frequency sounds, while the lateral line detects water motion at low frequencies and in the near-field (Hastings and Popper 2005).

Studies of the effects of human-generated sound on fish have been reviewed in numerous places (e.g., Hastings and Popper 2005; NRC 1994; Popper 2003;2008; Popper and Hastings 2009; Popper et al. 2004). Most investigations, however, have been in the gray literature (non-peer-reviewed reports—see Hastings and Popper (2005); Popper (2008); Popper and Hastings (2009) for extensive critical reviews of this material). Studies have been published assessing the effect on fish of short-duration, high-intensity signals such as might be found near high-intensity sonar, pile driving, or seismic air guns, none of which are part of the proposed activities considered in this consultation.

Studies of the effects of long-duration sounds with sound pressure levels (SPLs) below 170 to 180 dB re 1 μPa indicate that there is little to no effect of long-term exposure on species (such as those considered in this Opinion) that lack notable anatomical hearing specialization (Amoser and Ladich 2003; Scholik and Yan 2001; Smith et al. 2004a; Smith et al. 2004b; Wysocki et al. 2007). The longest of these studies exposed young rainbow trout (*Onorhynchus mykiss*), to a level of noise equivalent to one that fish would experience in an aquaculture facility (e.g., on the order of 150 dB re 1 μPa) for about 9 months. The investigators found no effect on hearing (i.e., TTS) as compared to fish raised at 110 dB re 1 μPa.

In contrast, studies on fish with hearing specializations (i.e., greater sensitivity to lower sound pressures and higher frequencies) have shown that there is some hearing loss after several days or weeks of exposure to increased background sounds, although the hearing loss seems to recover (e.g., Scholik and Yan 2002; Smith et al. 2006; Smith et al. 2004b). Smith et al. (2006) and Smith et al. (2004b) exposed goldfish to noise at 170 dB re 1 μPa and found a clear relationship between the amount of hearing loss (TTS) and the duration of exposure until maximum hearing loss occurred after 24 hours of exposure. A 10-minute exposure resulted in a 5 dB TTS, whereas a 3-week exposure resulted in a 28 dB TTS that took over 2 weeks to return to pre-exposure baseline levels (Smith et al. 2004b; Note: recovery time not measured by investigators for shorter exposure durations).

Similarly, Wysocki and Ladich (2005) investigated the influence of noise exposure on the auditory sensitivity of two freshwater fish with notable hearing specializations, the goldfish and the lined Raphael catfish (*Platydoras costatus*), and on a freshwater fish without notable specializations, the pumpkinseed sunfish (*Lepomis gibbosus*). Baseline thresholds showed greatest hearing sensitivity around 0.5 kHz in the goldfish and catfish and at 0.1 kHz in the sunfish. For the goldfish and catfish, continuous white noise of approximately 130 dB re 1 μPa at 1 m resulted in a significant TTS of 23 to 44 dB. In contrast, the auditory thresholds in the sunfish declined by 7 to 11 dB. The duration of exposure and time to recovery was not addressed in this study. Scholik and Yan (2001) demonstrated TTS in fathead minnows *(Pimephales promelas*) after a 24-hour exposure to white noise (0.3 to 2.0 kHz) at 142 dB re 1 μPa that did not recover as long as 14 days post-exposure.

Auditory masking refers to the presence of a noise that interferes with a fish's ability to hear biologically relevant sounds. Fish use sounds to detect both predators and prey, and for schooling, mating, and navigating (Popper 2003). Acoustic stressors during spawning migrations of ESA-listed fish species could lead to behavioral responses or auditory masking that affect an individual's ability to find a mate. Any noise (i.e., unwanted or irrelevant sound, often of an anthropogenic nature) detectable by a fish can prevent the fish from hearing biologically important sounds including those produced by prey or predators (Popper 2003). The frequency of the sound is an important consideration for fish because many marine fish are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (Amoser and Ladich 2005).

One of the problems with existing fish auditory masking data is that the bulk of the studies have been done with goldfish, a freshwater fish with well-developed anatomical specializations that enhance hearing abilities. The data on other species are much less extensive. As a result, less is known about masking in marine species, many of which lack the notable anatomical hearing specializations. However, Wysocki and Ladich (2005) suggest that ambient sound regimes may limit acoustic communication and orientation, especially in animals with notable hearing specializations.

Tavolga studied the effects of noise on pure-tone detection in two species without notable anatomical hearing specializations, the pin fish (*Lagodon rhomboids*) and the African mouthbreeder (*Tilapia macrocephala*), and found that the masking effect was generally a linear function of masking level, independent of frequency (Tavolga 1974a;b). In addition, Buerkle studied five frequency bandwidths for Atlantic cod in the 20 to 340 Hz region and showed masking across all hearing ranges (Buerkle 1969;1968). Chapman and Hawkins (1973) found that ambient noise at higher sea states in the ocean has masking effects in cod, *Gadus morhua* (L.), haddock, *Melanogrammus aeglefinus* (L.), and pollock, *Pollochinus pollachinus* (L.), and similar results were suggested for several sciaenid species by Ramcharitar and Popper (2004). Thus, based on limited data, it appears that for fish, as for mammals, masking may be most problematic in the frequency region near the signal. There have been a few field studies that suggest masking due to anthropogenic noise could have an impact on wild fish (de Jong et al. 2020).

Of considerable concern is that human-generated sounds could mask the ability of fish to use communication sounds, especially when the fish are communicating over some distance. In effect, the masking sound may limit the distance over which fish can communicate, thereby having an impact on important components of their behavior. For example, the sciaenids, which are primarily inshore species, are one of the most active sound producers among fish, and the sounds produced by males are used to "call" females to breeding sights (Ramcharitar et al. 2001; reviewed in Ramcharitar et al. 2006). If the females are not able to hear the reproductive sounds of the males, there could be a significant impact on the reproductive success of a population of sciaenids. Since most sound production in fish used for communication is generally below 500

Hz (Slabbekoorn et al. 2010), sources with significant low-frequency acoustic energy could affect communication in fish.

Also potentially vulnerable to masking is navigation by larval fish, although the data to support such an idea are still exceedingly limited. There is indication that larvae of some reef fish (species not identified in study) may have the potential to navigate to juvenile and adult habitat by listening for sounds emitted from a reef (either due to animal sounds or non-biological sources such as surf action; e.g., Higgs 2005).

In a study of an Australian reef system, the sound signature emitted from fish choruses was between 0.8 and 1.6 kHz (Cato 1978) and could be detected by hydrophones 3 to 4 nm from the reef (McCauley and Cato 2000). This bandwidth is within the detectable bandwidth of adults and larvae of the few species of reef fish, such as the damselfish, *Pomacentrus partitus*, and bicolor damselfish, *Eupomacentrus partitus*, that have been studied (Kenyon 1996; Myrberg Jr. 1980). At the same time, it has not been demonstrated conclusively that sound, or sound alone, is an attractant of larval fish to a reef, and the number of species tested has been very limited. Moreover, there is also evidence that larval fish may be using other kinds of sensory cues, such as chemical signals, instead of, or alongside of, sound (Atema et al. 2002).

*Sea Turtles*

The auditory system of sea turtles appears to work via water and bone conduction, with lower frequency sound conducted through skull and shell, and does not appear to function well for hearing in air (Lenhardt et al. 1985; Lenhardt et al. 1983). Sea turtles do not have external ears or ear canals to channel sound to the middle ear, nor do they have a specialized eardrum. Fibrous and fatty tissue layers on the side of the head may be the sound-receiving membrane in sea turtles, a function similar to that of the eardrum in mammals, or may serve to release energy received via bone conduction (Lenhardt et al. 1983). Sound is transmitted to the middle ear, where sound waves cause movement of cartilaginous and bony structures that interact with the inner ear (Ridgway et al. 1969). Unlike mammals, the cochlea of sea turtles is not elongated and coiled, and likely does not respond well to high frequencies, a hypothesis supported by a limited amount of information on sea turtle auditory sensitivity (Ridgway et al. 1969; Bartol et al. 1999). Investigations suggest that sea turtle auditory sensitivity is limited to low-frequency bandwidths, such as the sound of waves breaking on a beach, described below. The role of underwater low-frequency hearing in sea turtles is unclear. Sea turtles may use acoustic signals from their environment as guideposts during migration and as cues to identify their natal beaches (Lenhardt et al. 1983), but appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996) and light (Avens and Lohmann 2003).

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Moein Bartol and Musick 2003; Bartol and Ketten 2006), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues

(Hazel et al. 2007). Additionally, they are not known to produce sounds underwater for communication.

Available information suggests that the auditory capabilities of sea turtles are centered in the low frequency range (<2 kHz; Bartol et al. 1999; Dow Piniak et al. 2012; Lenhardt et al. 1994; Lenhardt et al. 1983; Martin et al. 2012; O'Hara and Wilcox 1990; Ridgway et al. 1969), with greatest sensitivity below 1 kHz. A more recent review on sea turtle hearing and sound exposure indicated that sea turtles detect sounds at less than 1,000 Hz (Popper et al. 2014). Research on leatherback sea turtle hatchlings using auditory evoked potentials showed the turtles respond to tonal signals between 50 and 1,200 Hz in water (maximum sensitivity 100 to 400 Hz; 84 dB re: 1uPa rms at 300 Hz; Dow Piniak et al. 2012).

Sea turtles may exhibit short-term behavioral reactions, such as swimming away or diving to avoid the immediate area around a source, although studies examining sea turtle behavioral responses to sound have used impulsive sources, not non-impulsive sources. Pronounced reactions to acoustic stimuli could lead to a sea turtle expending energy and missing opportunities to forage or breed. In nesting season, near nesting beaches, behavioral disturbances may interfere with nesting beach approach. In most cases, acoustic exposures are intermittent, allowing time to recover from an incurred energetic cost, resulting in no long-term consequence (NMFS 2018b).

*Marine Mammals*

Marine mammals use sound for communication, feeding, and navigation. Hearing has been directly measured in some odontocete and pinniped species (in air and underwater; see reviews in (Erbe 2015; Finneran et al. 2005; Southall et al. 2007). To better reflect marine mammal hearing, Southall et al. (2007) recommended that marine mammals be divided into hearing groups, and NMFS made modifications to these groups to divide pinnipeds into two groups and to recategorize hourglass and Peale’s dolphins (*Lagenorhynchus cruciger* and *Lagenorhynchus australis*, respectively) from mid-frequency to high-frequency cetaceans (NMFS 2016; 2018a; Table 4).

**Table 4. Marine Mammal Functional Hearing Groups (Southall et al. 2007; NMFS 2018a)**

| Hearing Group | Generalized Hearing Range |
|---|---|
| Low-frequency cetaceans<br>(baleen whales) | 7 Hz to 35 kHz |
| Mid-frequency cetaceans<br>(dolphins, toothed whales, beaked whales, bottlenose whales) | 150 Hz to 160 kHz |
| High-frequency cetaceans<br>(true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger*, *Lagenorhynchus australis*) | 275 Hz to 160 kHz |
| Phocid pinnipeds (underwater)<br>(true seals) | 50 Hz to 86 kHz |
| Otariid pinnipeds (underwater)<br>(sea lions and fur seals) | 60 Hz to 39 kHz |

The impetus for dividing marine mammals into functional hearing groups was to produce thresholds for each group for the onset of temporary and permanent threshold shifts (TTS and PTS, respectively). The 2016 NMFS guidance and 2018 revisions also include a protocol for estimating PTS onset thresholds for impulsive (e.g., airguns, impact hammer pile drivers) and non-impulsive (e.g., tactical sonar, vibratory pile drivers) sound sources. The action of icebreaking is a non-impulsive sound source. The thresholds serve as a tool to help evaluate the effects of activities employing different sound sources.

Noise-induced loss of hearing sensitivity or threshold shift refers to an ear's reduced sensitivity to sound within frequency bandwidths following exposure to different sound sources; when an ear's sensitivity to sound has been reduced, sounds must be louder for an animal to detect and recognize it. Noise-induced loss of hearing sensitivity is usually represented by the increase in intensity (in decibels) sounds must have to be detected. These losses in hearing sensitivity rarely affect the entire frequency range an ear might be capable of detecting, instead, they affect the frequency ranges that are roughly equivalent to or slightly higher than the frequency range of the noise itself (NMFS 2018b).

Acoustic exposures can result in three main forms of noise-induced losses in hearing sensitivity: permanent threshold shift, temporary threshold shift, and compound threshold shift (Ward et al. 1998; Yost 2007). When permanent loss of hearing sensitivity, or PTS, occurs, there is physical damage to the sound receptors (hair cells) in the ear that can result in total or partial deafness, or an animal's hearing can be permanently impaired in specific frequency ranges, which can cause the animal to be less sensitive to sounds in that frequency range. Traditionally, investigations of temporary loss of hearing sensitivity, or TTS, have focused on sound receptors (hair cell damage) and have concluded that this form of threshold shift is temporary because hair cell damage does not accompany TTS in these studies and losses in hearing sensitivity were determined to be short-term and are generally followed by a period of recovery to pre-exposure hearing sensitivity that can last for minutes, days, or weeks. More recently, however, Kujawa and Liberman (2009) reported on noise-induced degeneration of the cochlear nerve that is a delayed result of acoustic exposures that produce TTS, that occurs in the absence of hair cell damage, and that is irreversible. They concluded that the reversibility of noise induced threshold shifts, or TTS, can disguise progressive neuropathology that would have long-term consequences on an animal's ability to process acoustic information. If this phenomenon occurs in a wide range of species, TTS may have more permanent effects on an animal's hearing sensitivity than earlier studies would lead us to recognize (NMFS 2018b). In addition, there is no way of knowing the severity or degree of TTS an animal sustains from one or multiple exposures, which can either be minor or compounded over time. Therefore, while TTS is generally considered a less severe impairment compared to PTS, over time TTS may result in PTS.

Although the published body of science literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a strong sound, only a few studies provide empirical information on noise-induced loss in hearing sensitivity in marine mammals. Hearing loss due to auditory fatigue in marine mammals was studied by numerous investigators (Finneran et al. 2000; Schlundt et al. 2000; Finneran et al. 2002; Finneran et al. 2005; Finneran et al. 2007; Finneran and Schlundt 2010; Finneran et al. 2010; Southall et al. 2007; Kastak et al. 2007; Lucke et al. 2009; Mann et al. 2010; Mooney et al. 2009b; Mooney et al. 2009a; Nachtigall et al. 2003; Nachtigall et al. 2004; Popov et al. 2011). The studies of marine mammal auditory fatigue were all designed to determine relationships between TTS and exposure parameters such as level, duration, and frequency. In these studies, hearing thresholds were measured in trained marine mammals before and after exposure to intense sounds. The difference between the pre-exposure and post-exposure thresholds indicates the amount of TTS. Species studied include the bottlenose dolphin (total of nine individuals), beluga (2), harbor porpoise (1), finless porpoise (2), California sea lion (3), harbor seal (1), and northern elephant seal (1). Some of the more important data obtained from these studies are onset-TTS levels—exposure levels sufficient to cause a just-measurable amount of TTS, often defined as 6 dB of TTS (for example Schlundt et al. 2000).

Several variables affect the amount of loss in hearing sensitivity: the level, duration, spectral content, and temporal pattern of exposure to an acoustic stimulus as well as differences in the sensitivity of individuals and species. All of these factors combine to determine whether an individual organism is likely to experience a loss in hearing sensitivity as a result of acoustic exposure (Ward et al. 1998; Yost 2007). In most circumstances, free-ranging animals are not likely to remain in a sound field that contains potentially harmful levels of noise unless they have a compelling reason to do so (for example, if they must feed or reproduce in a specific location). Any behavioral responses that would take an animal out of a sound field or reduce the intensity of its exposure to the sound field would also reduce the animal's probability of experiencing noise-induced losses in hearing sensitivity (NMFS 2018b). Based on the evidence available from empirical studies of animal responses to human disturbance, marine animals, including mammals, are likely to exhibit one of several behavioral responses upon being exposed to sonar transmissions: (1) they may engage in horizontal or vertical avoidance behavior to avoid exposure or continued exposure to a sound that is painful, noxious, or that they perceive as threatening; (2) they may engage in evasive behavior to escape exposure or continued exposure to a sound that is painful, noxious, or that they perceive as threatening, which we would assume would be accompanied by acute stress physiology; (3) they may remain continuously vigilant of the source of the acoustic stimulus, which would alter their time budget. That is, during the time they are vigilant, they are not engaged in other behavior; and (4) they may continue their pre-disturbance behavior and cope with the physiological consequences of continued exposure (NMFS 2018b).

Masking is a phenomenon that affects animals that are trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow them to orient in their environment. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations. Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses produced by echosounders and submarine sonar (Watkins and Schevill 1975; Watkins 1985). They also stop vocalizing for brief periods when vocalizations are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995).

The echolocation calls of toothed whales are subject to masking by high frequency sound. Studies on captive odontocetes by Au (1993), Au et al. (1985), and Au et al. (1974) indicate that some species may use various processes to reduce masking effects (e.g., adjustments in echolocation call intensity or frequency as a function of background noise conditions). There is also evidence that the directional hearing abilities of odontocetes are useful in reducing masking at the high frequencies these cetaceans use to echolocate, but not at the low-to-moderate frequencies they use for communication (Zaitseva et al. 1980).

The occurrence of masking or hearing impairment provides a means by which marine mammals may be prevented from responding to the acoustic cues produced by their predators (NMFS 2018b). As with hearing loss, auditory masking can effectively limit the distance over which a marine mammal can communicate, detect biologically relevant sounds, and echolocate (odontocetes). Unlike auditory fatigue (temporary loss of hearing after exposure to sound resulting in a temporary shift of the auditory threshold or TTS), which always results in a localized stress response, behavioral changes resulting from auditory masking may not be coupled with a stress response. Another important distinction between masking and hearing loss is that masking only occurs in the presence of the sound stimulus, whereas hearing loss can persist after the stimulus is gone (NMFS 2018b).

Differential vocal responses in marine mammals has been documented in the presence of seismic survey noise. An overall decrease in vocalization during active surveying has been noted in large marine mammal groups (Potter et al. 2007), while blue whale feeding/social calls increased when seismic exploration was underway (Di Lorio and Clark 2010), indicative of a potentially compensatory response to the increased noise level. Similarly, Melcon et al. (2012) recently documented that blue whales decreased the proportion of time spent producing certain types of calls when mid-frequency sonar was present. At present, it is not known if these changes in vocal behavior corresponded to changes in foraging or any other behaviors (NMFS 2018b).

Additionally, some evidence suggests that at least some marine mammals have the ability to acoustically identify potential predators. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by certain groups of killer whales, but not others. The seals discriminate between the calls of threatening and non-threatening killer whales (Deecke et al. 2002), a capability that could increase survivorship while reducing the energy required for attending to and responding to all killer whale calls.

Marine animals, including mammals, have not had the time and have not experienced the selective pressure necessary for them to have evolved a behavioral repertoire containing a set of potential responses to active sonar, other potential stressors associated with naval military readiness activities, or human disturbance generally. Instead, marine animals invoke behavioral responses that are already in their behavioral repertoire to decide how they will behaviorally respond to active sonar, other potential stressors associated with naval military readiness activities, or human disturbance generally. An extensive number of studies have established that these animals will invoke the same behavioral responses they would invoke when faced with predation and will make the same ecological considerations when they experience human disturbance that they make when they perceive they have some risk of predation (Beale and Monaghan 2004; Frid and Dill 2002; Frid 2003; Gill and Sutherland 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). Specifically, when animals are faced with a predator or predatory stimulus, they consider the risks of predation, the costs of anti-predator behavior, and the benefits of continuing a pre-existing behavioral pattern when deciding which behavioral response is appropriate in a given circumstance (Bejder et al. 2009; Gill and Sutherland 2001; Houston et al. 1993; Lima 1998; Lima and Bednekoff 1999; Ydenberg and Dill 1986). Further, animals appear to detect and adjust their responses to temporal variation in predation risks (Lima and Bednekoff 1999; Rodriguez-Prieto et al. 2009).

### 5.4.2 **Vessel Noise**

Underwater sound from vessels is generally at relatively low frequencies, usually between 5 and 500 Hz (Hildebrand 2009; NRC 2003; Southall et al. 2017; Urick 1983; Wenz 1962). Low frequency ship noise sources include propeller noise (cavitation, cavitation modulation at blade passage frequency and harmonics, unsteady propeller blade passage forces), propulsion machinery such as diesel engines, gears, and major auxiliaries such as diesel generators (Ross 1976). High levels of vessel traffic are known to elevate background levels of noise in the marine environment (Andrew et al. 2011; Chapman and Price 2011; Frisk 2012; Miksis-Olds et al. 2013; Redfern et al. 2017; Southall 2005). Anthropogenic sources of sound in the action areas includes smaller vessels such as skiffs, larger vessels for pulling barges to deliver supplies to communities or industry work sites, icebreakers, and vessels for tourism and scientific research which all produce varying noise levels and frequency ranges. Commercial ships radiate noise underwater with peak spectral power at 20–200 Hz (Ross 1976). The dominant noise source is usually propeller cavitation which has peak power near 50–150 Hz (at blade rates and their harmonics), but also radiates broadband power at higher frequencies, at least up to 100,000 Hz (Arveson and Vendittis 2000; Gray and Greeley 1980; Ross 1976). While propeller singing is caused by blades resonating at vortex shedding frequencies and emits strong tones between 100 and 1,000 Hz, propulsion noise is caused by shafts, gears, engines, and other machinery and has peak power below 50 Hz (Richardson et al. 1995b). Overall, larger vessels generate more noise at low frequencies (<1,000 Hz) because of their relatively high power, deep draft, and slower-turning engines (<250 rotations per minute) and propellers (Richardson et al. 1995b). As shown in Table 3, small vessels used by the USCG have a frequency range from 1,000 to 7,000 Hz while the polar icebreakers have a frequency range from 20 to 300 Hz.

One potential effect from vessel noise is auditory masking that can lead animals to miss biologically relevant sounds that species may rely on, as well as eliciting behavioral responses such as an alert, avoidance, or other behavioral reaction (NRC 2003;2005; Williams et al. 2015). There can also be physiological stress from changes to ambient and background noise. The effects of masking can vary depending on the ambient noise level within the environment, the received level, frequency of the vessel noise, and the received level and frequency of the sound of biological interest (Clark et al. 2009; Foote et al. 2004; Parks et al. 2010; Southall et al. 2000). In the open ocean, ambient noise levels are between about 60 and 80 dB re: 1 μPa, especially at lower frequencies (below 100 Hz; NRC 2003). When the noise level is above the sound of interest, and in a similar frequency band, auditory masking could occur (Clark et al. 2009). Any sound that is above ambient noise levels and within an animal’s hearing range needs to be considered in the analysis. The degree of masking increases with the increasing noise levels; a noise that is just detectable over ambient levels is unlikely to actually cause any substantial masking above that which is already caused by ambient noise levels (NRC 2003;2005).

Southall et al. (2007) synthesized data from many past behavioral studies and observations to determine the likelihood of behavioral reactions at specific sound levels. While in general, the louder the sound source the more intense the behavioral response, it was clear that the proximity of a sound source and the animal’s experience, motivation, and conditioning were also critical factors influencing the response (Southall et al. 2007). After examining all of the available data, the authors felt that the derivation of thresholds for behavioral response based solely on exposure level was not supported because context of the animal at the time of sound exposure was an important factor in estimating response. Nonetheless, in some conditions consistent avoidance reactions were noted at higher sound levels dependent on the marine mammal species or group allowing conclusions to be drawn. Most low-frequency cetaceans (mysticetes) observed in studies usually avoided sound sources at levels of less than or equal to 160 dB re: 1 μPa rms. Published studies of mid-frequency cetaceans analyzed include sperm whales, belugas, bottlenose dolphins, and river dolphins. These groups showed no clear tendency, but for non-impulsive sounds, captive animals tolerated levels in excess of 170 dB re: 1 μPa rms before showing behavioral reactions, such as avoidance, erratic swimming, and attacking the test apparatus. High-frequency cetaceans (observed from studies with harbor porpoises) exhibited changes in respiration and avoidance behavior at levels between 90 and 140 dB re: 1 μPa rms, with profound avoidance behavior noted for levels exceeding this. Phocid seals showed avoidance reactions at or below 190 dB re: 1 μPa rms, thus seals may actually receive levels adequate to produce TTS before avoiding the source. Recent studies with beaked whales have shown them to be particularly sensitive to noise, with animals during 3 playbacks of sound breaking off foraging dives at levels below 142 dB re: 1 μPa rms, although acoustic monitoring during actual sonar exercises revealed some beaked whales continuing to forage at levels up to 157 dB re: 1 μPa rms (Tyack et al. 2011).

### 5.4.3 Aircraft Noise

The MH-60 Jayhawk, which is likely to be the aircraft used as part of the action, is an all-weather, medium range helicopter (specialized for search and rescue). The USCG also uses UASs for air reconnaissance (USCG 2019). Helicopters produce low-frequency sound and vibration (Pepper et al. 2003; Richardson et al. 1995b). Noise generated from helicopters is transient in nature and variable in intensity. Helicopter sounds contain dominant tones from the rotors that are generally below 500 Hz. MH-60 noise levels at the helicopter average approximately 136 dB re: 20 μPa in air with frequencies between 20 Hz and 5 kHz. More low frequency components (<1 kHz) are contained in this broad band signal primarily from rotor noise (i.e., helicopter blade rotation). Helicopters often radiate more sound forward than aft. As shown in Table 3, the helicopters used by the USCG have a frequency range of 20 to 5,000 Hz (in air).

Sound levels generated by UASs have not been well-documented. However, two multi-rotor UASs were measured to produce broad-band in-air source levels of 80 decibels referenced at 20 μPa with frequencies centered at 60 to 150 Hz. When flying at altitudes of 16 to 33 ft (5 to 10 m) above the water's surface, the received levels of these UASs were considered to be close to ambient noise levels in many shallow water habitats and below the hearing thresholds of most marine mammals (Christiansen et al. 2016). A fixed-wing UAS is expected to be quieter than quad-copters. The USCG informed NMFS that UASs used would likely be short range quad-copter type that will operate at low altitides. If any medium or long-range UASs are used, these are typically operated above 1,000 ft.

Most of the acoustic energy from an aircraft arrives through a relatively narrow cone extending vertically downward from the aircraft (Eller and Cavanaugh 2000; Richardson et al. 1995b). This cone creates a “footprint” directly beneath the flight path, with the width of the footprint (at the water’s surface) being a function of aircraft altitude. Furthermore, in-air noise decreases with distance, with a decrease in sound level from any single noise source following the “inverse-square law.” In other words, the Sound Pressure Level changes in inverse proportion to the square of the distance from the sound source. Therefore, aircraft sound levels actually at the air-water interface (i.e., sea surface) is a function of how high above the surface the aircraft is flying or hovering. Thus, the higher the aircraft, the less sound reaches the sea surface (Eller and Cavanaugh 2000; Richardson et al. 1995b). Any sound produced by an UAS is expected to be less than that produced by a helicopter (USCG 2019).

Transmission of sound from a moving airborne source to a receptor underwater is influenced by numerous factors and has been addressed by Urick (1983), Young (1973), Richardson et al. (1995b), and Eller and Cavanaugh (2000). Sound is transmitted from an airborne source to a receptor underwater by four principal means: (1) a direct path, refracted upon passing through the air-water interface; (2) direct refracted paths reflected from the bottom in shallow water; (3) evanescent transmission in which sound travels laterally close to the water surface; and (4) scattering from interface roughness due to wave motion (USCG 2019).

Aircraft sound is refracted upon transmission into water because sound waves move faster through water than through air (a ratio of about 0.23:1). Based on this difference, the direct sound path is reflected if the sound reaches the surface at an angle more than 13 degrees from vertical. As a result, most of the acoustic energy transmitted into the water from an aircraft arrives through a relatively narrow cone extending vertically downward from the aircraft. Traveling beyond the sea surface, the sound values in air and in water are not directly comparable due to the reference units used, and must be converted. The result is that sound waves with the same intensities in water and air have relative intensities that differ. The USCG calculated this difference as 26 dB and noted that this amount must be added to sound levels in air referenced to 20 μPa to obtain the sound level in water referenced to 1 μPa. The USCG then added another 6 dB (doubling of pressure across interface) to take into consideration the air-water interface, such that 26 dB + 6dB or 32 dB would have to be added to any in air value to estimate its corresponding in water transition value (e. g., 100 dB re: 20 μPa in air + 26 dB +6 dB = 132 dB re: 1 μPa in water;USCG 2019).

NMFS believes this calculation may be appropriate for something at the water surface but the difference in the relative sound pressures between air and water is not as simple as adding or subtracting 26 dB from a measured sound in air or water to convert to the other medium. Because water is much denser than air, water has higher impedance. The impedance of water is about 3600 times (10 log 3600 = 36) times that of air because sound travels faster in water than in air. Thus, sounds of equal measured pressure will be measured at 36 dB higher in water than in air. So, unlike the reference pressure correction described by the USCG (the 26dB), the difference is not only between the air and water pressures, but also the impedence of water. This means it is actually 26 + 36 dB = 62 dB, which is a difference of 62 dB higher in water than in air. Using the USCG example, sound measuring 100 dB in air will correspond to a sound measuring 162 dB in water, not 132. Therefore, the sound at 1 m below the water surface (within that narrow cone) is likely higher than what the USCG calculated.

The inhomogeneous nature of sea ice does not necessarily allow for attenuation of noise from the air through an ice layer and into the water. When aircraft noise passes from air to water, there is a limiting ray of 13 degrees, where the noise will be reflected off the surface of the water instead of passing through (Richardson et al. 1995b). At frequencies less than 500 Hz, the ice layer is acoustically thin and causes little attenuation of sound (Richardson et al. 1991). It is expected that transmission of low-frequency sound through ice would be only slightly lower than that of low-transmission sound travelling directly from the air into the water (Richardson et al. 1995b). Use of the air-water transmission model would provide slight overestimates of underwater sound levels from aircraft overflights, but this is the best model currently available to analyze airborne sound transmission through ice (Richardson et al. 1995b). If ice is present beneath aircraft operations, noise levels would be lowered by the time they reach the ice from an overhead flight and would still have to attenuate through the ice and the resulting underwater noise would be generally brief in nature.

### 5.4.4 Equipment Noise

It is assumed that future navigational systems would operate similarly to systems used by the existing polar icebreakerss in the USCG fleet. An echosounder measures the round trip time it takes for a pulse of sound to travel from the source at the vessel to the sea bottom and return. When mounted to the vessel, it is called a fathometer. Typical low frequency equipment operates at 12 kHz and high frequency equipment at 200 kHz. The major difference between various types of echosounders is the frequency. Transducers can be classified according to their beam width, frequency, and power rating. Beam width is determined by the frequency of the pulse and the size of the transducer. In general, lower frequencies produce a wider beam, and at a given frequency, a smaller transducer would produce a wider beam. Lower frequencies penetrate deeper into the water, but have less resolution at depth. Higher frequencies have a greater resolution in depth, but less range. The frequency range (3.5 to 1,000 kHz, Table 3) of the single-beam echosounder that will be the most-used navigation equipment in polar icebreakers does overlap with the hearing range of certain marine species.

The echosounder's system operates in a wide range of frequencies (between 50 and 200 kHz). Although there is a lack of audiometry data, based on anatomical studies and analysis of sounds that they produce, most baleen whales hear best at low frequencies, from 7 Hz to 35 kHz (Table 4). Watkins (1986) stated that humpback whales often react to frequencies from 15 Hz to 28 kHz, but did not react to frequencies above 36 kHz. Fin and right whales also often react to frequencies from 15 Hz to 28 kHz, but did not react frequencies above 36 kHz (Watkins 1986). Similarly, ESA-listed sea lions hear best between 60 Hz to 39 kHz (Table 4: Kastak and Schusterman 1998; Moore and Schusterman 1987; Schusterman et al. 1972; Southall 2005), and are unlikely to detect any frequency used by Coast Guard echosounders.

ESA-listed sea turtles are not expected to detect signals emitted by the singlebeam echosounders associated with the action area, as the operating frequency range is well outside the hearing range of sea turtles. Most fish species can hear sounds between 50 and 1,000 Hertz (Hz). Fish without hearing specialization are not expected to detect signals emitted by the singlebeam echosounders associated with the action, as the operating frequency range of these devices is about 3.5–1000 kHz, which is well outside the hearing range of these fish. The ESA-listed fish species expected to come in contact with underwater acoustic transmissions are generally regarded as lacking any hearing specializations (Hastings and Popper 2005). Salmonids (including salmon and steelhead species) can likely detect sounds up to 380 Hz (Hastings and Popper 2005; Hawkins and Johnstone 1978). To date, salmon and sturgeon have only been tested to about 400 or 800 Hz and their sensitivity to higher frequencies is not known. The 380 Hz described here (Hawkins and Johnstone 1978) is for Atlantic salmon, and is often used as a surrogate for other salmonid species. Elasmobranchs (sharks and rays), like all fish, have an inner ear capable of detecting sound and a lateral line capable of detecting water motion caused by sound (Hastings and Popper 2005 ; Popper and Hastings 2009). Research on these species indicates they can detect sounds between 20 to 1,000 Hz, with best sensitivity within the lower ranges and cannot hear sounds at frequencies above 1,000 Hz. (Casper et al. 2003; Casper and Mann 2006;2009; Myrberg 2001).

### 5.5 Icebreaking

Icebreaking vessels used in the Arctic for activities including research and oil and gas activities and in Antarctica for research activities produce louder, but also more variable, sounds than those associated with other vessels of similar power and size during icebreaking operations. The greatest sound generated during icebreaking operations is produced by cavitation of the propeller as opposed to the engines or the ice on the hull; estimated source levels for icebreakers range from 164-189 dB re: 1 μPa 1 m rms (Roth et al. 2013). Even with rapid attenuation of sound in heavy ice conditions, the elevation in noise levels attributed to icebreaking can be substantial out to at least 3 miles. In some instances, icebreaking sounds are detectable from more than 31 miles away (Greene and Moore 1995) underneath the waterline. Appendix A contains information regarding modeling conducted by the USCG to determine the potential thresholds for impacts to marine mammals as a result of icebreaking noise. Appendix B contains a discussion of next steps to refine the analysis of potential acoustic impacts of icebreaking to marine mammals as part of the MMPA authorization process for the operation of new icebreakers that will be part of step-down consultation.

In addition to the acoustic effects of icebreaking, icebreakers can crush individual ringed seals or mothers and pups while they occupy their subnivean lairs in spring (Kelly et al. 2010) and affect habitat used by ice seals. Currently the use of icebreakers on the North Sea Route keeps shipping lanes in the Barents and Kara Seas open through pack ice at a time when bearded seals are hauling out in peak numbers to whelp and molt (O'Rourke 2010). Segments of the Northwest Passage are used as ice conditions permit in the Canadian Arctic, confining most traffic to the late summer when bearded seals are thought to be largely aquatic (Cameron et al. 2010). Because icebreaking activities are expected to increase in the Arctic, the likelihood of impacts to marine mammals in the Arctic operation area is expected to increase (Kelly et al. 2010) over the time period of the action.

## 5.6 Entanglement and Entrapment

Entanglements can result in death or injury of marine mammals and sea turtles (Moore et al. 2009; Van der Hoop et al. 2012). Marine mammal entanglement, or by-catch, is a global problem that every year results in the death of hundreds of thousands of whales, dolphins, porpoises, and pinnipeds (seals, sea lions, etc.) world-wide. Entangled marine mammals may drown or starve due to being restricted by gear, suffer physical trauma and systemic infections, and/or be hit by vessels due to an inability to avoid them. For smaller marine mammals, like dolphins, death is typically quick, and due to drowning. However, large whales, like the humpback whale, can typically pull gear, or parts of it, off the ocean floor, and are generally not in immediate risk of drowning. Depending on the entanglement, towing gear (especially heavy gear attached to traps, for example) for long periods can prevent a whale from being able to feed, migrate, or reproduce. Entanglement can also cause injury that can lead to secondary infection, loss of appendages such as fins and tail flukes, or cause death (Moore 2014). As noted in a previous section, whales do become entangled in taught or loose cables, similar to or the same as towing cables that may be used by the USCG. Entanglement in cables may occur when whales are lunge feeding and accidently get wrapped in a cable.

Entrapment in gear, such as in towed devices, power plant intake structures, or hopper dredges, has caused numerous injuries and usually death to ESA-listed sea turtles and fish. Some animals may become dislodged and freed, but remain stunned, stressed, or sustain injuries from which they may not be able to recover. Many sources of entrapment risk have been reduced due to regulation and updates to gear, but it remains a potential stressor.

The 2017 stranding report for Alaska (https://alaskafisheries.noaa.gov/pr/strandings) indicates that strandings due to entanglement in marine debris affected 24 Steller sea lions, 5 humpback whales (and 3 unidentified cetaceans), 2 bowhead whales, 1 ringed seal, and 1 gray whale. In 2018, a humpback was found to have died as a result of entanglement in crab gear the Pacific Northwest. In 2017, a gray whale calf was found to have died as a result of entanglement in fishing gear and a humpback whale was entangled in buoys and ropes in 2010 off the coast of Washington (http://www.cascadiaresearch.org/projects/stranding-response). Data from the West Coast Marine Mammal Stranding Network indicate that entrainment was the reason for 4 percent of pinniped strandings associated with human interactions from 2007 to 2016 (https://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/cetaceans/mm_stranding_10yeardata_q_a_final_2018.pdf).

In the case of the activities to be conducted by the icebreakers, vessel escort and tow have the potential to result in entanglement or entrapment of ESA-listed species such as ice seals while lines are slack, as can environmental response training, particularly when gear such as booms are deployed.

# 6 Status of Endangered Species Act Protected Resources

This section identifies the ESA-listed species and designated critical habitat that potentially occur within the action area (Table 5) that may be affected by the proposed delivery and operation of up to six new icebreakers. This section first identifies the species and designated critical habitats in the action area that may be affected, but are not likely to be adversely affected by the operation of the new icebreakers. The remaining species and designated critical habitats deemed likely to be adversely affected by icebreaker operation in the action area are carried forward through the remainder of this Opinion.

**Table 5. Threatened and Endangered Species That May Be Affected by the USCG's Construction and Operation of New Icebreakers**

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| **Marine Mammals – Cetaceans** | | | |
| Blue Whale (*Balaenoptera musculus)* | E – 35 FR 18319 | -- -- | 07/1998 |
| Bowhead Whale (*Balaena mysticetus*) | E – 35 FR 18319 | -- -- | -- -- |
| Fin Whale (*Balaenoptera physalus)* | E – 35 FR 18319 | -- -- | 75 FR 47538 |
| Humpback Whale (*Megaptera novaeangliae*) - Western North Pacific, Central America, and Mexico DPSs | E – Western North Pacific and Central America DPSs<br>T – Mexico DPS<br>81 FR 62259 | 84 FR 54354 (Proposed) | 11/1991 |
| Gray Whale (*Eschrichtius robustus*) – Western North Pacific DPS | E – 35 FR 18319<br>and revised listing E – 59 FR 31094 | -- -- | -- -- |
| North Pacific Right Whale (*Eubalaena japonica*) | E – 73 FR 12024 | 73 FR 19000 | 78 FR 34347 |
| North Atlantic Right Whale (*Eubalaena glacialis*) | E – 73 FR 12024 | 81 FR 4837 | 70 FR 32293 |
| Southern Right Whale (*Eubalaena australis*) | E – 35 FR 8491 | -- -- | -- -- |
| False Killer Whale (*Pseudorca crassidens*) - Main Hawaiian Islands Insular DPS | E – 77 FR 70915 | 83 FR 35062 | -- -- |
| Sei Whale (*Balaenoptera borealis*) | E – 35 FR 18319 | -- -- | 12/2011 |
| Killer Whale (*Orcinus orca*) - Southern Resident DPS | E – 70 FR 69903<br>Amendment 80 FR 7380 | 71 FR 69054 | 73 FR 4176 |

| Species | ESA Status | Critical Habitat | Recovery Plan |
| --- | --- | --- | --- |
| Sperm Whale (*Physeter macrocephalus*) | E – 35 FR 18319 | -- -- | 75 FR 81584 |
| **Marine Mammals – Pinnipeds** | | | |
| Ringed Seal (*Phoca hispida hispida*) – Arctic Subspecies | T – 77 FR 76706 | 79 FR 73010 (Proposed) | -- -- |
| Bearded Seal (*Erignathus barbatus*) – Beringia DPS | T – 77 FR 76739 | -- -- | -- -- |
| Guadalupe Fur Seal (*Arctocephalus townsendi*) | T – 50 FR 51252 | -- -- | -- -- |
| Hawaiian Monk Seal (*Neomonachus schauinslandi*) | E – 41 FR 51611 | 80 FR 50925 | 72 FR 46966<br>2007 |
| Steller Sea Lion (*Eumetopias jubatus*) – Western DPS | E – 55 FR 49204 | 58 FR 45269 | 73 FR 11872<br>2008 |
| **Sea Turtles** | | | |
| Green (*Chelonia mydas*) – North Atlantic, South Atlantic, East Indian-West Pacific Ocean, Central North Pacific Ocean, Central South Pacific Ocean, East Pacific Ocean, Southwest Indian Ocean, and Southwest Pacific DPSs | E – Central South Pacific Ocean DPS<br>T - rest of DPSs in action area<br>81 FR 20057 | 63 FR 46693<br>(North Atlantic DPS only) | U.S. Atlantic – 10/1991<br>U.S. Pacific – 63 FR 28359 |
| Loggerhead (*Caretta caretta*) – North Pacific Ocean, South Pacific Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, Southwest Indian Ocean, Southeast Indo-Pacific Ocean DPS | E – North Pacific, South Pacific, and Northeast Atlantic DPSs<br>T - rest of DPSs in action area<br>76 FR 58868 | 79 FR 39855 (Northwest Atlantic Ocean DPS only) | U.S. Pacific – 63 FR 28359<br>Northwest Atlantic - 74 FR 2995<br>U.S. Caribbean, Atlantic, and Gulf of Mexico - 10/1991<br>U.S. Pacific - 05/1998<br>Northwest Atlantic - 01/2009 |
| Leatherback (*Dermochelys coriacea*) | E – 35 FR 8491 | 44 FR 17710 and 77 FR 4170 | U.S. Caribbean, Atlantic, and Gulf of Mexico - 63 FR 28359<br>U.S. Pacific - 05/1998 |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| Kemp's Ridley (*Lepidochelys kempii*) | E – 35 FR 18319 | -- -- | U.S. Caribbean, Atlantic, and Gulf of Mexico - 09/2011 (2nd revision) |
| Olive Ridley (*Lepidochelys olivacea*) – Mexico's Pacific Coast Breeding Populations, All Other Populations | E – Mexico's Pacific Coast Breeding Populations<br>T – All Other<br>43 FR 32800 | -- -- | Mexico's Pacific Coast - 63 FR 28359 |
| Hawksbill Turtle (*Eretmochelys imbricata)* | E – 35 FR 8491 | 63 FR 46693 | U.S. Caribbean, Atlantic, and Gulf of Mexico - 57 FR 38818<br>U.S. Pacific - 63 FR 28359 |
| **Fishes** | | | |
| Shortnose sturgeon (*Acipenser brevirostrum*) | E – 32 FR4001 | -- -- | 63 FR 69613 |
| Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Gulf of Maine and South Atlantic DPS | E – South Atlantic DPS<br>T – Gulf of Maine DPS<br>77 FR 5879 | 82 FR 39160 | -- -- |
| Green Sturgeon (*Acipenser medirostris*) – Southern DPS | T – 71 FR 17757 | 74 FR 52300 | 2010 (Outline) |
| Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) | T – 56 FR 49653 | 68 FR 13370 | 09/1995 |
| Bocaccio (*Sebastes paucispinis*) – Puget Sound DPS | E – 75 FR 22276 and amendment 82 FR 7711 | 79 FR 68041 | 81 FR 54556 (Draft) |
| Altantic Salmon (*Salmo salar*)– Gulf of Maine DPS | E – 74 FR 29344 | 74 FR 39903 | 70 FR 75473 and 81 FR 18639 (Drafts) |
| Chinook Salmon (*Oncorhynchus tshawytscha*) – Sacramento River Winter-Run, Upper Columbia River Spring-Run, Snake River Spring/Summer-Run, Snake River Fall- | 70 FR 37160 | Sacramento River Winter-Run - 58 FR 33212 | Sacramento River Winter-Run and Central Valley |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| Run, Central Valley Spring-Run, California Coast, Puget Sound, Lower Columbia River, and Upper Willamette River Evolutionary Significant Units (ESUs) | | Upper Columbia River Spring-Run and Upper Willamette River - 70 FR 52629<br>Snake River Spring/Summer-Run - 64 FR 57399<br>Snake River Fall-Run - 58 FR 68543<br>Central Valley Spring-Run and California Coast - 70 FR 52488<br>Puget Sound and Lower Columbia River - 70 FR 52629 | Spring-Run - 79 FR 42504<br>Upper Columbia River Spring-Run - 72 FR 57303<br>Snake River Spring/Summer-Run - 81 FR 74770 (Draft)<br>Snake River Fall-Run - 80 FR 67386 (Draft)<br>California Coast - 81 FR 70666<br>Puget Sound - 72 FR 2493<br>Lower Columbia River - 78 FR 41911<br>Upper Willamette River - 76 FR 52317 |
| Chum Salmon (*Oncorhynchus keta*) – Hood Summer-Run and Columbia River ESUs | T – 70 FR 37160 | 70 FR 52629 | Hood Summer-Run - 72 FR 29121<br>Columbia River - 78 FR 41911 |
| Coho Salmon (*Oncorhynchus kisutch*) – Central California Coast, Southern Oregon/Northern California Coasts, Lower Columbia River, and Oregon Coast ESUs | E - Central California Coast<br>T - rest of ESUs in action area (Southern Oregon/Northern California Coasts, Lower Columbia River)<br>70 FR 37160<br>Oregon Coast - 73 FR 7816 | Central California Coast, Southern Oregon/Northern California Coasts - 64 FR 24049<br>Lower Columbia River - 81 FR 9251<br>Oregon Coast - 73 FR 7816 | Central California Coast - 77 FR 54565<br>Southern Oregon/Northern California Coasts - 79 FR 58750<br>Lower Columbia River - 78 FR 41911<br>Oregon Coast - 81 FR 90780 |
| Sockeye Salmon (*Oncorhynchus nerka*) – Snake River and Ozette Lake ESUs | E - Snake River<br>T - Ozette Lake<br>70 FR 37160 | Snake River - 58 FR 68543<br>Ozette Lake - 70 FR 52630 | Snake River - 80 FR 32365<br>Ozette Lake - 74 FR 25706 |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| | | | |
| Pacific Eulachon (*Thaleichthys pacificus*) – Southern DPS | T – 75 FR 13012 | 76 FR 65323 | 9/2017 |
| Steelhead Trout (*Oncorhynchus mykiss*) – Southern California, Upper Columbia River, Snake River Basin, Middle Columbia River, Lower Columbia River, Upper Willamette River, South-Central California Coast, Central California Coast, Northern California, California Central Valley, and Puget Sound DPSs | E - Southern California<br>T - All other DPSs in action area<br>72 FR 26722 | Southern California, South-Central California Coast, Central California Coast, Northern California, California Central Valley - 70 FR 52487<br>Upper Columbia River, Snake River Basin, Middle Columbia River, Lower Columbia River, Upper Willamette River - 70 FR 52629<br>Puget Sound - 81 FR 9251 | Southern California - 77 FR 1669<br>Upper Columbia River - 72 FR 57303<br>Snake River Basin - 81 FR 74770 (Draft)<br>Middle Columbia River - 74 FR 50165<br>Lower Columbia River - 78 FR 41911<br>Upper Willamette River - 76 FR 52317<br>South-Central California Coast - 78 FR 77430<br>Central California Coast, Northern California - 81 FR 70666<br>California Central Valley - 79 FR 42504 |
| Yelloweye Rockfish (*Sebastes ruberrimus*) | T - 82 FR 7711 | 79 FR 68041 | 81 FR 54556 (Draft) |
| Nassau Grouper (*Epinephelus striatus*) | T – 81 FR 42268 | -- -- | -- -- |
| Giant Manta Ray (*Manta birostris*) | T – 83 FR 2916 | -- -- | -- -- |
| Oceanic Whitetip Shark (*Carcharhinus longimanus*) | T – 83 FR 4153 | -- -- | -- -- |
| Scalloped Hammerhead Shark (*Sphyrna lewini*) – Central and Southwest Atlantic, Eastern Atlantic, | T - Central and Southwest Atlantic, Indo-West Pacific | -- -- | -- -- |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| Eastern Pacific, Indo-West Pacific DPSs | E - Eastern Atlantic, Eastern Pacific<br>79 FR 38213 | | |
| Daggernose Shark (*Isogomphodon oxyrhynchus*) | E – 82 FR 21722 | -- -- | -- -- |
| Blackchin Guitarfish (*Rhinobatos cemiculus*) | T – 82 FR 6309 | -- -- | -- -- |
| Narrow Sawfish (*Anoxypristis cuspidata*) | E – 79 FR 73977 | -- -- | -- -- |
| Smalltooth Sawfish (*Pristis pectinata*) | E – 68 FR 15674 | 74 FR 45353 | 74 FR 3566 |
| **Corals** | | | |
| Elkhorn Coral (*Acropora palmata*) | T – 79 FR 53851 | 73 FR 72210 | 80 FR 12146 |
| Staghorn Coral (*Acropora cervicornis*) | T – 79 FR 53851 | 73 FR 72210 | 80 FR 12146 |
| Lobed Star Coral (*Orbicella annularis*) | T – 79 FR 53851 | -- -- | -- -- |
| Boulder Star Coral (*Orbicella franksi*) | T – 79 FR 53851 | -- -- | -- -- |
| Mountainous Star Coral (*Orbicella faveolata*) | T – 79 FR 53851 | -- -- | -- -- |
| Pillar Coral (*Dendrogyra cylindrus*) | T – 79 FR 53851 | -- -- | -- -- |
| Rough Cactus Coral (*Mycetophyllia ferox*) | T – 79 FR 53851 | -- -- | -- -- |
| *Acropora globiceps* | T – 79 FR 53851 | -- -- | -- -- |
| *Acropora lokani* | T – 79 FR 53851 | -- -- | -- -- |
| *Acropora retusa* | T – 79 FR 53851 | -- -- | -- -- |
| *Acropora speciosa* | T – 79 FR 53851 | -- -- | -- -- |
| *Euphyllia paradivisa* | T – 79 FR 53851 | -- -- | -- -- |
| *Isopora crateriformis* | T – 79 FR 53851 | -- -- | -- -- |
| *Seriatopora aculeata* | T – 79 FR 53851 | -- -- | -- -- |
| *Siderastrea glynni* | E – 80 FR 60560 | -- -- | -- -- |
| Black Abalone (*Haliotis cracherodii*) | E – 74 FR 1937 | 76 FR 66805 | -- -- |
| White Abalone (*Haliotis sorenseni*) | E – 66 FR 29046 | -- -- | 73 FR 62257 |

In order to determine which species may be affected by the different activities proposed by the USCG as part of icebreaker operations, the table below indicates which species are present in each of the operation areas (Pacific Northwest, Arctic, and Antarctic) and which species will be encountered only when the vessels are in transit from one operation area to another or from the icebreaker's homeport to the operation areas (Table 6). Tables 1 and 2 (Section 3) show the specific activities that will be conducted in each of the operation areas and the expected annual frequency of each of these activities, respectively. Table 7 identifies the designated and proposed critical habitats in each of the operation areas or only within areas through which the icebreakers will transit. Note that transit includes anchoring and mooring in foreign and domestic ports along anticipated transit routes to and from the Antarctic operation area.

**Table 6. ESA-Listed Species (see Table 5) Present in Each of the Operation Areas and Species Present Only Along Expected Transit Routes To/From Operation Areas**

| Operation Area | Cetaceans | Pinnipeds | Sea Turtles | Fish | Invertebrates |
|---|---|---|---|---|---|
| Pacific Northwest[1] | Blue, Fin, Gray (Western North Pacific DPS), Humpback (Central America and Mexico DPSs), Southern Resident Killer, North Pacific Right, Sei, and Sperm Whales | Steller Sea Lion (Western DPS); Guadalupe Fur Seal | Leatherback | Bocaccio (Puget Sound/Gergia Basin DPS); Chinook (all listed ESUs), Chum (both ESUs), Coho (all listed ESUs), and Sockeye Salmon (both ESUs); Steelhead Trout (all DPSs); Eulachon (Southern DPS); Yelloweye Rockfish (Puget Sound/Georgia Basin DPS); Green Sturgeon (Southern DPS) | None |
| Arctic | Blue, Fin, Humpback (Western North Pacific and Mexico DPSs), Gray (Western North Pacific DPS), North Pacific Right, Sei, Sperm, and Bowhead Whales | Steller Sea Lion (Western DPS); Ringed (Arctic Subspecies) and Bearded (Beringia DPS) Seals | Leatherback | Green (Southern DPS) Sturgeon; Chinook (Lower Columbia River, and Upper Willamette River ESUs), Coho (Lower Columbia River ESU), Chum (Columbia River ESU), and Sockeye (both ESUs) Salmon; Steelhead Trout | None |

| | | | | | |
|---|---|---|---|---|---|
| | | | | (Puget Sound, Lower Columbia River, Middle Columbia River, Snake River Basin, Upper Columbia River, and Upper Willamette River ESUs) | |
| Antarctic | Southern Right, Blue, Fin, Sperm, and Sei Whales | None | None | None | None |
| **Transit Only*** | Humpback (Cape Verde/Northwest Africa DPS), North Atlantic Right, and False Killer (Main Hawaiian Islands Insular DPS) | Hawaiian Monk Seal | Green (all DPSs), Loggerhead (all DPSs), Olive Ridley (all populations), Hawksbill Sea Turtles | Shortnose, Atlantic (both DPSs), and Gulf Sturgeons; Nassau Grouper; Giant Manta Ray; Oceanic Whitetip, Scalloped Hammerhead (all DPSs), and Daggernose Sharks; Blackchin Guitarfish; Narrow and Smalltooth Sawfish; Chinook (Upper Columbia River Spring-Run, Snake River Fall-Run, Snake River Spring-Summer Run, and Puget Sound ESUs), Chum (Hood Summer-Run ESU) | White and Black Abalone; All ESA-Listed Corals in Table 5 |

* Species listed in this row are not expected to be present in any of the 3 operation areas and will be encountered only during transit of icebreakers. Cetacean, pinniped, sea turtle, and some fish species from the operation areas with broader ranges (such as global or along the West Coast) would also be affected by vessel transit in the action area but are not repeated in this row.

[1] Some of these species are also within the expected homeport of the new vessels in Seattle, Washington.

There are rare reports of hard shell turtles, specifically green, loggerhead, and olive ridley that have strayed into the cold waters of Alaska. Approximately 20 green, 2 loggerhead, 4 olive ridley, and 3 live unidentified sea turtles have been recorded in Alaska since the 1960s (Hodge and Wing 2000; Ream 2012; Woodford 2011). The low frequency of occurrence of hard shell turtles in waters of Alaska indicates they are straying beyond their range of tolerance (Hodge and Wing 2000) and most of the sightings involved individuals that were either cold-stressed, likely to become cold-stressed, or deceased (Hodge and Wing 2000; McAlpine et al. 2002). Therefore, we do not include these species as present in the Arctic operation area. Similarly, hard shell turtles are rare in the cold waters of the Pacific Northwest operation area, which are also considered outside the normal range for these species. We do not include hard shell turtles as present in the Pacific Northwest operation area either.

**Table 7. Designated and Proposed Critical Habitat in Each of the Operation Areas and Along Expected Transit Routes To/From Operations Areas**

| Operation Area | Cetaceans | Pinnipeds | Sea Turtles | Fish | Invertebrates |
|---|---|---|---|---|---|
| Pacific Northwest | Southern Resident Killer Whale Critical Habitat[1] and Proposed Humpback Whale Critical Habitat (Central America DPS and Mexico DPS) | None | Leatherback Sea Turtle (U.S. Pacific – WA/OR Coast) Critical Habitat | Green Sturgeon, Bocaccio, Yelloweye Rockfish, Steelhead Trout (Puget Sound ESU), Chum Salmon (Hood Canal Summer Run ESU), and Chinook Salmon (Puget Sound ESU) Critical Habitat[1] | None |
| Arctic | North Pacific Right Whale Critical Habitat and Proposed Humpback Whale Critical Habitat (Northwest Pacific DPS and Mexico DPS) | Ringed Seal (Arctic Subspecies; Proposed), and Steller Sea Lion (Western DPS; Alaska) Critical Habitat | None | None | None |
| Antarctic | None | None | None | None | None |
| **Transit Only*** | North Atlantic Right Whale, and False | Hawaiian Monk Seal, and Steller | Loggerhead Sea Turtle (Breeding, Migratory and | | Black Abalone Critical Habitat |

| | | | | | |
|---|---|---|---|---|---|
| | Killer Whale (Main Hawaiian Islands Insular DPS) Critical Habitat | Sea Lion (Western DPS, West Coast) Critical Habitat | Winter Habitat along East Coast, Northwest Atlantic DPS), Leatherback Sea Turtle (U.S. Pacific – CA Coast) Critical Habitat | | |

*Critical habitat identified in this row does not overlap with any of the operation areas but may be encountered during transit to and from these areas.

[1] Although this critical habitat is not within the proposed Pacific Northwest operation area, it is within the expected homeport of the new icebreakers in Seattle, Washington so we include it here.

## 6.1 Species and Designated Critical Habitat Not Likely to be Adversely Affected

NMFS uses two criteria to identify the ESA-listed or designated critical habitat that are not likely to be adversely affected by the action, as well as the effects of activities that are consequences of the Federal agency's action. The first criterion is exposure, or some reasonable expectation of a co-occurrence, between one or more potential stressors associated with the proposed activities and ESA-listed species or designated critical habitat. If we conclude that an ESA-listed species or designated critical habitat is not likely to be exposed to the proposed activities, we must also conclude that the species or critical habitat is not likely to be adversely affected by those activities.

The second criterion is the probability of a response given exposure. ESA-listed species or designated critical habitat that co-occurs with a stressor of the action but is not likely to respond to the stressor is also not likely to be adversely affected by the action. We applied these criteria to the ESA-listed species in Table 5 and we summarize our results below.

In the case of the proposed construction and operation of up to six new icebreakers, ESA-listed species and designated critical habitat occur in waters affected by the operation of the new icebreakers, including the activities detailed in Section 3.1.

The probability of an effect on a species or designated critical habitat is a function of exposure intensity and susceptibility of a species to a stressor's effects (i.e., probability of response). An action warrants a "may affect, not likely to be adversely affected" finding when its effects are wholly *beneficial, insignificant*, or *extremely unlikely to occur*.

*Beneficial* effects have an immediate positive effect without any adverse effects to the species or habitat. *Insignificant* effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. Insignificant is the appropriate effect conclusion when plausible effects are going to happen, but will not rise to the level of constituting an adverse effect. For an effect to be *extremely unlikely to* *occur*, there must be a plausible adverse effect (i.e., a credible effect that could result from the action and that would be an adverse effect if it did affect a listed species), but it is very unlikely to occur.

### 6.1.1 Vessel Transit and Noise Throughout Action Area

Icebreakers will transit from their homeport (currently Seattle is considered the likely homeport for new icebreakers) to the Arctic, Pacific Northwest, and Antarctic operation areas. Table 2 shows the frequency of each activity icebreakers will engage in based on operation area. Thus, this table also represents the frequency at which icebreakers will be in transit in different portions of the action area. During transit, the most common stressors will be noise from vessel motors and navigation equipment and the potential for vessel strike. Vessel anchoring is another stressor that may occur in the action area associated mainly with transiting if the icebreakers need to use designated anchorage areas associated with existing ports. The USCG preferentially uses ports with adequate facilities to allow icebreakers to moor to piers so anchoring is not expected to be frequent.

Table 3 shows the frequency range (in kHz) for sound sources associated with the action including small and large vessels, icebreaking, navigational equipment, helicopters, and gunnery exercises. In the transit only portions of the action area (i.e., outside the operation areas in the Pacific Northwest, Arctic, and Antarctic), there will be no icebreaking, gunnery exercises, or aircraft operations. Icebreaking, gunnery exercises and aircraft operations are discussed below in the sections for each of the operation areas.

<u>Vessel Noise and Noise from Navigation Equipment</u>

Given that the range of best hearing for ESA-listed sea turtles appears to be 100 to 400 Hz and below 400 Hz for ESA-listed fish, ESA-listed sea turtles and fish in the action area (Table 5) are not expected to detect signals emitted by the navigation equipment used by the icebreakers while underway. The frequency range for operation of small vessels is also outside the hearing range of sea turtles and ESA-listed fish in the action area (Table 5) so noise from operation of small vessels is not expected to affect ESA-listed sea turtles and fish in the action area. Therefore, we believe the noise from the operation of navigational equipment and small vessels as part of the action will have no effect on any of the ESA-listed sea turtles and fish in the action area.

The hearing range of marine mammals is highly variable based on the hearing group of the animals (Table 4). Unlike ESA-listed sea turtles and fish, all marine mammals in the action area (Table 5) are likely to detect a range of sounds, including acoustic signals from navigational equipment and motor noise from small vessels. Based on the U.S. Navy's definition of acoustic sources defined as de minimis (Navy 2018), any in-water active acoustic source with narrow beam widths, downward-directed transmissions, short pulse lengths, frequencies outside known hearing ranges, low source levels, or a combination of any of these factors are not expected to result in adverse effects. Although the frequency range of navigational equipment (50 to 200 kHz) does overlap with the hearing range of mid and high-frequency cetaceans and true seals underwater, these animals are expected to exhibit no more than short-term, minor responses to navigation equipment due to their characteristics of having narrow beam widths and downward-directed beams focused below the vessel. Therefore, we believe the effects of noise from the operation of navigational equipment as part of the action will be insignificant and is not likely to adversely affect the ESA-listed marine mammals in the action area.

Icebreakers are large vessels that emit low frequency sound with peak source level around 190 dB (re 1 uPa @ 1m) between 20 to 300 Hz. These sounds are within the hearing range of all ESA-listed marine mammals (see Table 4) including mysticetes; odontocetes; true seals; and sea lions and fur seals in the action area. Given the sound propagation of low frequency sounds, a large vessel in this sound range can be heard 139 to 463 km away (Polefka 2004). Small vessel noise, including low frequency sounds when small vessels are accelerating, is also within the hearing range of all the marine mammal species that may be present in the action area.

Numerous studies of interactions between surface vessels and marine mammals have demonstrated that free-ranging marine mammals engage in avoidance behavior when surface vessels move toward them. Several authors suggest that the noise generated during motion is probably an important factor (Blane and Jaakson 1994; Evans et al. 1992; Evans et al. 1994). Studies suggest that the behavioral responses of marine mammals to surface vessels are similar to their behavioral responses to predators. Most of the investigations reported that animals tended to reduce their visibility at the water's surface and move horizontally away from the source of disturbance or adopt erratic swimming strategies (Corkeron 1995; Van Parijs and Corkeron 2001; Lundquist et al. 2012; Lusseau 2003;2004; Nowacek et al. 2001; Williams et al. 2002b; Williams et al. 2002a). In the process, their dive times increased, vocalizations and surface-active behaviors were reduced (with the exception of beaked whales), individuals in groups moved closer together, swimming speeds increased, and their direction of travel took them away from the source of disturbance (Baker and Herman 1989; Edds and Macfarlane 1987; Evans et al. 1992; Kruse 1991). Some individuals also dove and remained motionless, waiting until the vessel moved past their location. Most animals finding themselves in confined spaces, such as shallow bays, during vessel approaches tended to move towards more open, deeper waters (Kruse 1991). Richardson et al. (1985) reported that bowhead whales (*Balaena mysticetus*) swam in the opposite direction of approaching seismic vessels at distances between 1 and 4 km and engaged in evasive behavior at distances under 1 km.

Although many studies focus on small cetaceans (for example, bottlenose dolphins, spinner dolphins, spotted dolphins, harbor porpoises, beluga whales, and killer whales), studies of large whales have reported similar results for fin and sperm whales (David 2002). Fin whales also responded to vessels at a distance of about 1 km (Edds and Macfarlane 1987). Fin whales may alter their swimming patterns by increasing speed and heading away from a vessel, as well as changing their breathing patterns in response to a vessel approach (Jahoda et al. 2003). Vessels that remain 328 ft. (100 m) or farther from fin and humpback whales were largely ignored in one study where whale-watching activities are common (Watkins 1981). Only when vessels approached more closely did the fin whales in this study alter their behavior by increasing time at the surface and exhibiting avoidance behaviors. Other studies have shown when vessels are near, some but not all fin whales change their vocalizations, surface time, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions (Au and Green 2000; Castellote et al. 2012; Richter et al. 2003; Williams et al. 2002b). Sperm whales generally react only to vessels approaching within several hundred meters; however, some individuals may display avoidance behavior, such as quick diving (Magalhaes et al. 2002; Wursig et al. 1998). One study showed that after diving, sperm whales showed a reduced timeframe from when they emitted the first click than before vessel interaction (Richter et al. 2006).

Based on passive acoustic recordings and in the presence of sounds from passing vessels, Melcon et al. (2012) reported that blue whales had an increased likelihood of producing certain types of calls. In the presence of approaching vessels, blue whales perform shallower dives accompanied by more frequent surfacing, but otherwise do not exhibit strong reactions (Calambokidis et al. 2009). Castellote et al. (2012) demonstrated that fin whales' songs had shortened duration and decreased bandwidth, center frequency, and peak frequency in the presence of high shipping noise levels. It is not known if these changes in vocal behavior corresponded to other behaviors.

In a study by Watkins (1981), humpback whales did not exhibit any avoidance behavior but did react to vessel presence. In a study of regional vessel traffic, Baker et al. (1983) found that when vessels were in the area, the respiration patterns of the humpback whales changed. The whales also exhibited two forms of behavioral avoidance: horizontal avoidance (changing direction or speed) when vessels were between 1.24 and 2.48 mi. (2,000 and 4,000 m) away, and vertical avoidance (increased dive times and change in diving pattern) when vessels were within approximately 1.2 mi (2,000 m; Baker and Herman 1983). Similar findings were documented for humpback whales when approached by whale watch vessels in Hawaii (Au and Green 2000). Gende et al. (2011) reported on observations of humpback whales in inland waters of Southeast Alaska subjected to frequent cruise ship transits (i.e., in excess of 400 transits in a 4-month season in 2009). The study was focused on determining if close encounter distance was a function of vessel speed. The reported observations, however, seem in conflict with other reports of avoidance at much greater distance so it may be that humpback whales in those waters are more tolerant of vessels (given their frequency) or are engaged in behaviors, such as feeding, that they are less willing to abandon.

Sei whales have been observed ignoring the presence of vessels and passing close to them (NMFS 1993). North Atlantic right whales tend not to respond to the sounds of oncoming vessels (Nowacek et al. 2004) and therefore might provide insight into behavioral responses of other baleen whales. North Atlantic right whales continue to use habitats in high vessel traffic areas (Nowacek et al. 2004). Studies showed that North Atlantic right whales demonstrate little if any visible reaction to sounds of vessels approaching or the presence of the vessels themselves

(Nowacek et al. 2004; Terhune and Verboom 1999). However, reduced ship traffic in the Bay of Fundy, Canada that led to a 6 dB decrease in underwater noise with a significant reduction below 150 Hz was associated with decreased baseline levels of stress-related faecal hormone metabolites in North Atlantic right whales (Rolland et al. 2012). This suggests that exposure to low-frequency ship noise may be associated with chronic stress in whales with implications for all baleen whales in heavy ship traffic areas.

Killer whales, the largest of the delphinids, are targeted by numerous small whale-watching vessels in the Pacific Northwest. For the 2012 season, it was reported that 1,590 vessel incidents were possible violations of the federal vessel approach regulations or MMPA and ESA laws as well (Eisenhardt 2013). Research suggests that whale-watching distances may be insufficient to prevent behavioral disturbances due to vessel noise (Noren et al. 2009). The effects of vessel activity is one of the three main threats to the survival of this population. As such, whale-watching activities, and specifically, viewing distances, are currently being reviewed and revised. The Southern Resident Orca Task Force published recommendations related to decreasing disturbance of and risk to Southern Resident killer whales from small vessels and commercial whale-watching vessels including "go-slow" requirements within half a nm of the animals, a limited-entry whale-watching permit system, recreational boater education, and improving enforcement (https://smea.uw.edu/about/student-blog/blog/the-southern-resident-killer-whale-task-force-are-the-recommendations-enough/). Since 1998, the number of active commercial whale-watching vessels has increased from 63 in 1999 to 96 in 2015 (Seely et al. 2017). The number of vessel incidents or violation of regulations and guidelines has also increased from 398 in 1998 to 2,621 in 2012 (Seely et al. 2017). These vessels have measured source levels that ranged from 145 to 169 dB re: 1 μPa at 1 m rms. The sound they produce underwater has the potential to result in behavioral disturbance, interfere with communication, and affect the killer whales' hearing (Erbe 2002b). Killer whales foraged significantly less and traveled significantly more when boats were within 328 ft. (100 m) (100 m; Kruse 1991; Lusseau et al. 2009; Trites and Bain 2000; Williams et al. 2002b; Williams and Noren 2009). These short-term feeding activity disruptions may have important long-term population level effects (Lusseau et al. 2009; Noren et al. 2009). The reaction of the killer whales to whalewatching vessels may be in response to the vessel pursuing them, rather than to the noise of the vessel itself, or to the number of vessels in their proximity.

ESA-listed sea turtles and fish are also expected to detect low frequency noise associated with large vessel operation based on their hearing ranges. However, based on available information, ESA-listed sea turtles and fish are not likely to respond to visual (Moein Bartol and Musick 2003; Bartol and Ketten 2006) or sound stressors from icebreakers that are at a distance and are expected to continue current behavior (feeding, swimming, breeding, etc.), as are marine mammals. Closer interactions with vessels and ESA-listed sea turtles may elicit avoidance behavior such as diving and fast swimming, which may result in short interruptions in feeding and other behaviors (NMFS 2018b).

Similar to other consultations for the use of military vessels in training and testing activities (including in areas encompassed by the action area for this consultation) and based on available information, we conclude that ESA-listed marine mammals, sea turtles, and fish in the action area are likely to either not react or to exhibit avoidance behavior. Most avoidance responses would consist of movements away from vessels, perhaps accompanied by slightly longer dives by marine mammals and turtles (NMFS 2015b). Most of the temporary changes in behavior would consist of a shift from behavioral states with low energy requirements like resting, to states with higher energy requirements like active swimming, with the animals then returning to the lower energy behavior. For behavioral responses to result in energetic costs that result in longterm harm, such disturbances would likely need to be sustained for a significant duration or extent where individuals exposed would not be able to select alternate habitat to recover and feed.

Transit of icebeakers through the action area would not likely result in such prolonged exposures and preclusion of individuals from feeding, breeding, or sheltering habitat. Thus, we do not expect ESA-listed species to respond to icebreaker vessel and navigation equipment operation noise or to respond measurably in ways that would significantly disrupt normal behavior patterns including breeding, feeding, or sheltering. Therefore, we believe the effects of noise from icebreakers on ESA-listed marine mammals, sea turtles, and fish in the action area will be insignificant and thus not likely to adversely affect these animals. We also believe the effects of noise from small vessel operation on ESA-listed marine mammals will be insignificant and thus not likely to adversely affect these animals.

Noise from vessel transit and the use of navigation equipment is expected to have little effect on the physical characteristics of designated critical habitat (Table 7) in the action area. If vessels do move through areas of critical habitat during transit operations, vessel presence will be extremely short-term and any noise from transit and navigation equipment operation of a single icebreaker will be indistinguishable from other vessel traffic in areas containing designated critical habitat. The USCG will use existing ports and harbors during transit and does not expect icebreakers to anchor rather than mooring at piers as harbor areas with adequate capacity for large vessels are preferred by the USCG during transit to and from operation areas. If anchoring is necessary, it would occur in areas designated for this purpose associated with a particular port.

For designated and proposed critical habitat that includes physical and biological features (PBFs), such as the presence of copepods or other prey items used by ESA-listed species, the noise from the operation of vessels and navigation equipment is not expected to be distinguishable from other vessel traffic. Any disturbance of prey species associated with an icebreaker transiting through an area of designated critical habitat would be temporary and is not expected to alter the function of the essential features. We believe the effects of noise from vessel transit and navigation equipment on designated critical habitat in the action area would be extremely unlikely to occur and therefore not likely to adversely affect these habitats.

Vessel Strike

Based on information from the USCG, there are no reports of vessel strikes of ESA-listed whales by icebreakers. There have been two reported whale strikes by USCG cutters in 2017 and 2019, respectively, that have been confirmed by NMFS. Neilson et al. (2012) report a USCG cutter strike of a large whale from their analysis of reported whale/vessel collisions in Alaska waters from 1978-2011. There are no records of vessel strikes of smaller ESA-listed marine mammals, particularly ice seals; however, due to the size of the vessel versus the size of seals, as well as the possibility that a collision could involve seals under the ice may mean that collisions go unobserved, particularly if there are no observable signs such as blood in the water. This is discussed further in Section 8 as part of the analysis of the effects of icebreaking activities.

Based on information from the USCG (USCG 2017;2019), during post-delivery testing, an icebreaker will transit at full power, which is approximately 18 knots, and at speeds of 12 to 17 knots during propulsion testing. During gunnery training, icebreakers will transit at speeds of 6 to 10 knots. During ice condition testing, icebreakers will transit at speeds of 3 to 6 knots and at 4 to 5 knots when escorting and towing a vessel. When icebreaking, icebreakers transit at a speed of 3 knots. Speeds used by support vessels vary greatly and depend on the activity in which the vessel(s) is engaged. For instance, during environmental response training, support vessels transit at speeds up to 3 knots but up to 30 knots during SAR training. When used as over-the-horizon boats for law enforcement, support vessels also transit up to 30 knots. Passenger transfers typically occur at speeds up to 15 knots (USCG 2019). When transiting from its homeport to an operation area, icebreakers are likely to transit at an average speed of 15 knots, though speed of transit will depend on sea and weather conditions and where the vessel is transiting in relation to potential navigational hazards. Most lethal and severe injuries are caused by vessels larger than 262.5 feet and the probability of fatal injuries to whales from vessel strikes increases as vessels operate at speeds above 14 knots (Laist et al. 2001). Icebreakers are large vessels and sometimes operate at speeds above 14 knots, particularly during maneuverability testing, although while transiting the vessels will operate at a speed close to this threshold.

In terms of ESA-listed whales in the action area, Jensen and Silber (2004) review of the NMFS ship strike database revealed fin whales as the most frequently confirmed victims of ship strikes (26 percent of the recorded ship strikes [n = 75/292 records]), with most collisions occurring off the east coast, followed by the west coast of the U.S. and Alaska/Hawaii. Five of seven fin whales stranded along Washington State and Oregon showed evidence of vessel strike with incidence increasing since 2002 (Douglas et al. 2008). Blue whale mortality and injuries attributed to vessel strikes in California waters averaged roughly one every other year (Jensen and Silber 2004) but in mid-September 2007, vessels struck five blue whales within a span of eleven days off southern California (Berman-Kowalewski et al. 2010). More recently, Rockwood et al. (2017) estimated ship strike mortality for blue, humpback, and fin whales off the west coast of the U.S. based on strike data and determined blue whales were most likely to suffer mortality followed by humpback and fin whales. The majority of ship strike mortality occurs in waters off

California with 82, 74, and 65 percent of the humpback, blue, and fin whale mortality, respectively, occurring in this area from Bodega Bay south in a band approximately 25 nm offshore and in shipping lanes to and from major ports (Rockwood et al. 2017).

For whales, including ESA-listed whales, in waters in and near the Arctic operation area, Figure 4 shows the locations of the 108 reported whale-vessel collisions by species from 1978 to 2011 (Neilson et al. 2012). Of these collisions, the sperm (one collision) and gray (one collision) whales were confirmed dead. Two of the three fin whales and 17 of the 93 humpback whales involved in collisions with vessels were also confirmed dead. As discussed in Section 5.1, in 2017, there were seven reports of vessel strikes to humpback whales, one of an unidentified cetacean, and one of a sperm whale, which was struck by a USCG cutter in the Gulf of Alaska area. There was also a whale strike in August 2019 by a USCG cutter that NMFS believes may have caused the mortality of a humpback whale. Since 2000, there have also been 4 reported ship strikes of Steller sea lions, all within the Gulf of Alaska area (https://alaskafisheries.noaa.gov/pr/strandings).

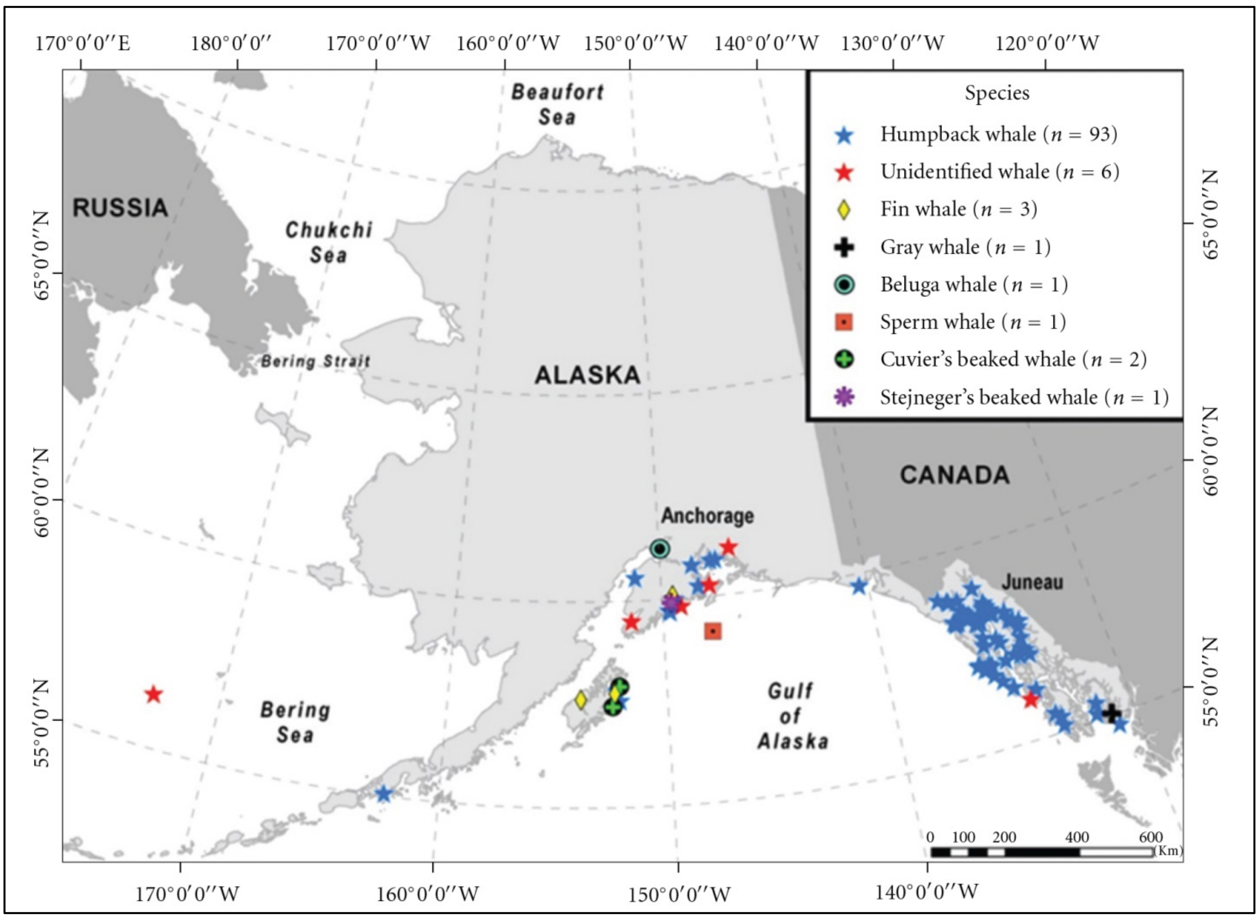


**Figure 4. Locations of vessel strikes of whales reported in Alaska waters from 1978 to 2011 (Neilson et al. 2012)**

Two species of right whales could be impacted by vessel activities. North Atlantic right whales are highly vulnerable to ship collisions but would be encountered by icebreakers only during transit to to/from Greenland. North Pacific right whales cross a major shipping lane when traveling to and from the Bering Sea and the probability of ship strike mortality may increase with future changes in sea ice leading to the opening of the Northwest Passage (Wade et al. 2011). At this time, no vessel collisions or propeller strikes of North Pacific right whales have been documented in the Bering Sea despite the presence of these whales, including in designated critical habitat areas for the species, one of which is in the Bering Sea.

The most likely areas and reasons for vessel strikes of ESA-listed marine mammals are collisions with commercial vessels along major shipping routes and near and within harbors. The information on vessel strikes (Neilson et al. 2012; Rockwood et al. 2017) indicate there are low numbers reported in the proposed operation areas. A maximum of two icebreakers would be transiting in the action area at a given time and would have a dedicated lookout looking for marine mammals. Support vessels are used infrequently during training and transfer activities and also have a dedicated lookout. Based on information provided by the USCG, despite the decades-long operation of icebreakers in the action area, there are no reports of collisions between an icebreakeror one of its support vessels and an ESA-listed marine mammal. Therefore, we believe the risk of vessel strike by icebreakers and associated support vessels to ESA-listed marine mammals during transit will be extremely low and therefore extremely unlikely to occur and not likely to result in adverse effects.

Vessel collisions with sea turtles occur throughout the action area, though most are reported as between smaller vessels operating at high speeds, particularly recreational vessels in nearshore waters. Consultations completed with the Navy concluded that the potential for vessel strikes of sea turtles was similar to that of collision with recreational and commercial vessels and could not be easily quantified but was likely to be so low as to be extremely unlikely to occur (NMFS 2015b;2018b). Similarly, vessel collisions with ESA-listed fish species are rare and are largely confined to restricted water bodies where shallow waters can lead to collisions with large fish like sturgeon. The icebreakers will operate in restricted water bodies only when icebreaking, in areas where no ESA-listed fish species are expected to be present, and when entering and exiting some port areas, including the likely homeport of the vessels in Seattle, Washington. However, even in these restricted water bodies, navigation routes are in deeper waters maintained through dredging to support the transit of larger vessels such as icebreakers. The USCG has been operating polar icebreakers out of Seattle and in the three operation areas considered in this Opinion for decades with no reports of vessel collisions with fish or sea turtles based on information provided by the USCG. Therefore, we believe the risk of vessel collisions to ESA-listed sea turtles and fish will be extremely unlikely to occur and thus not likely to result in adverse effects.

In terms of critical habitat, PBFs include prey species' availability and maintenance of water quality for designated critical habitat such as that for North Pacific right whale and Steller sea lion, as well as proposed critical habitat for the Western North Pacific, Central America, and Mexico DPSs of humpback whales. Regular discharges from vessels could cause temporary declines in prey species due to the impacts of pollutants in the discharge with the extent of effects depending on the size of regular discharge. Vessel discharges could also result in temporary declines in water quality, though the severity of impacts would depend on the chemical constituents in the discharge and their toxicity to marine organisms. Vessel discharges and associated concentrations of contaminants in these discharges are expected to be small based on required compliance with regulations of discharges from vessels of the armed forces Therefore, we believe the potential effects of regular vessel discharges from icebreakers while in transit through designated and proposed critical habitats in the action area are extremely unlikely to occur and thus not likely to adversely affect designated and proposed critical habitats.

### 6.1.2 Activities in the Pacific Northwest Operations Area

In the Pacific Northwest operation area, activities that are part of the action include post-delivery and propulsion testing for the new icebreakersgunnery training, and environmental response training. Vessel noise during operations was already analyzed in Section 6.1.1 and will not be discussed again in this section. The ESA-listed species that may be affected by these activities in the Pacific Northwest operation area are listed in Table 6.

Maneuverability testing will occur once per year for two hours at a time with the vessel moving at full power potentially over a two-day period. One vessel is engaged in this testing, meaning there is no measurable increase in large vessel traffic in the area. Post-delivery maneuverability testing will take place for each new icebreaker once it has transited from its site of construction to its homeport and for each icebreaker as it comes out of dry dock. This testing involves the operation of the vessel at full power. Sea trial maneuverability testing involves the operation of the icebreaker at speeds of 12 to 17 knots while conducting maneuvers including turning. Maneuverability testing has the potential to lead to vessel strikes of ESA-listed species due to the speed at which vessels are operated for each type of test. Sea trials also have the potential to result in vessel strikes while turning vessels rapidly.

Based on information from consultations with the Navy, which conducts training and testing activities in their Northwest Training Range Complex where the Pacific Northwest operation area is located, there have not been any vessel strikes during training activities in the range over the five-year period from 2010-2015 or any since an ESA section 7 consultation was completed for the 2015 to 2020 training and testing period. While ship speeds of 15 knots or higher, which is the speed above which the icebreaker will operate during maneuverability testing, are known to result in a marked increase in intensity of centerline impacts to whales and propeller suction effect (Silber et al. 2010), most ship strikes are caused by commercial vessels rather than military vessels (NMFS 2015b). Military vessels use lookouts during training activities and these lookouts receive training in marine species detection in order to minimize the potential for interactions with vessels. There has only been one reported incident of a Navy vessel striking a whale in the Pacific Northwest from 1994 to 2015. The strike occurred off the coast of Oregon while the vessel was transiting from Seattle. The whale (thought to be a minke whale) swam away and there was no observable evidence of injury, such as blood in the water.

Steller sea lions (Western DPS) and Guadalupe fur seals are not likely to be in the Pacific Northwest operation area given its distance offshore. These species are more likely to be located closer to the coast. Guadalupe fur seal strandings have recently increased in the Pacific Northwest and, in 2019, Oregon and Washington were added to the states included in the Unusual Mortality Event (UME) that began in California. Guadalupe fur seals also travel up to 800 km offshore (Norris and Elorriaga Verplancken 2019) so could be within the action area, but is not considered common in the Pacific Northwest. Only a very small fraction of the Steller sea lions along the Pacific Northwest coast are from the listed DPS, most are from the unlisted DPS. Steller sea lions are typically found in coastal waters along the continental shelf but occasionally forage in deep waters off the continental shelf particularly during the non-breeding season. There are no reports of Steller sea lions from consultations with the Navy for training and testing activities in this area.

Leatherback sea turtles could be in the Pacific Northwest operation area but this species is present in low numbers and there are no documented cases of Navy vessels in the Pacific Northwest training area striking a sea turtle. Stranding data from 1963 to 2016 indicate stranding locations of leatherback sea turtles along the west coast were concentrated along central and southern California with no strandings reported for Alaska, Oregon or Washington from 1994 to 2016 (Center for Biological Diversity and Turtle Island Restoration Network 2019). A total of 151 strandings were reported over this period with peaks of up to 15 turtles in a single year reported in the 1990s, thought to be due largely to entanglement in fishing gear. Vessel strikes accounted for a small percentage of strandings, particularly outside of California. Similarly, we do not expect vessel strikes to ESA-listed fish species. Vessel strikes to ESA-listed species do occur occasionally in rivers and other restricted habitat areas where larger fish such as sturgeon are present and the water depth versus vessel draft does not allow for unrestricted passage of these larger animals around vessels but are not reported in deep coastal waters such as those in the Pacific Northwest operation area.

Therefore, we believe the possibility of an icebreaker striking an ESA-listed marine mammal, leatherback sea turtle, or fish in the Pacific Northwest operation area (Table 6) is so unlikely as to be extremely unlikely to occur and not likely to result in adverse effects to these animals.

Dive team training will occur every other patrol and/or enough to maintain proficiency of divers for up to two hours at a time in any of the proposed operation areas, though this training is likely to occur while in port and in the other two operation areas rather than frequently in the Pacific Northwest based on information provided by the USCG. Dive operations will also be infrequent, occurring on an as-needed basis, particularly to assist with repairs in the case of vessel operations in the Pacific Northwest operation area. Ship husbandry and other dive operations to address regular maintenance will occur while at dock. Dive training and operations, particularly those involving the placement of temporary structures like cofferdams or patches on vessels that do occur in the Pacific Northwest have the potential to result in the discharge of contaminants and debris to marine waters. Dive training and operations occur while the vessel is stationary, which is why most activities involving divers will take place while in port. If the vessel is not in port and the need arises for divers to assist such as in the case of a maintenance need, the vessel might anchor in order to stay in place. If vessels need to anchor to allow dive operations outside of a port, minor impacts to habitat from the deployment of an icebreaker's anchor could occur. However, given the extent of habitat areas used by ESA-listed species in the Pacific Northwest, impacts from anchor deployment would not be expected to result in a significant loss of habitat. In addition, based on information from the USCG, the thickness of the icebreaker's hull makes it unlikely that divers would be needed for hull repair. In addition, vessels could stop dead and drift on the water rather than anchoring, depending on the location. Because of the nature of dive activities, including the use of divers immediately around the vessel while it is stationary, the likelihood that divers will be in the water in a port, and the infrequent nature of dive operations in particular in waters outside ports, we believe the potential effects of dive training and operations to ESA-listed marine mammals, leatherback sea turtles, and fish in the Pacific Northwest operation area (Table 6) will be insignificant and not likely to adversely affect these animals.

Gunnery training will occur twice per year for one hour using non-explosive rounds fired from gun mounts at a floating target ("killer tomato"). Gunnery training will result in marine debris in the form of spent practice rounds and target fragments. Projectiles will fall on soft or hard bottom habitats where they could be buried in sediment or sit on the bottom. Projectiles will be fired at surface targets, which will absorb most of the energy from firing before projectiles strike the water and sink, limiting the possibility of high-velocity impacts with any ESA-listed species present at or near the water surface. A total of 500 non-explosive rounds per year (2 events per year with up to 250 rounds fired during each training event) could enter the water. While disturbance or strike from rounds or targets is possible, it is not very likely because these items sink through the water column slowly, meaning animals can see and avoid them. Targets have a greater potential for disturbance of ESA-listed species due to the possibility for entanglement (if lines are on the target) and ingestion of fragments. Entanglement can result in death or injury of marine mammals and sea turtles (Hanni and Pyle 2000; Moore et al. 2009; Van Der Hoop et al. 2012), as well as fish. Animals may mistake expended materials for food, particularly in the case of small items, or incidentally ingest materials along with prey while foraging, in the case of targets. There has never been a reported or recorded instance of a marine mammal or sea turtle entangled in military expended materials or of ingestion of these materials (NMFS 2015b;2018b). Because one target will be used during each training event and the USCG will attempt to recover targets, in addition to using lookouts to ensure training activities do not interfere with marine mammals and sea turtles, we believe the effects of expended gunnery training materials on leatherback sea turtles and ESA-listed marine mammals in the Pacific Northwest operation area (Table 6) will be extremely unlikely to occur and therefore not likely to adversely affect these animals.

Entanglement may pose a greater threat for ESA-listed fish species given their use of large portions of the Pacific Northwest as habitat (NMFS 2015b). Entanglement of fish is more likely when materials form loops or incorporate rings, which is why discarded fishing gear often results in entanglement (Derraik 2002; Keller et al. 2010; Laist 1987; Macfadyen et al. 2009). Physical features such as the snouts of sawfish and sturgeon increase the risk of entanglement. Small metal items like hooks, bottle caps, and springs have been reported as eaten by marine fish, posing physical and toxicological risks (Davison and Asch 2011; Dantas et al. 2012; Possatto et al. 2011). Small caliber projectiles could therefore be ingested by some fish species as they move downward through the water column and settle on the bottom, depending on the feeding habitats of the fish. The expected densities of ESA-listed fish species (particularly salmonids and eulachon based on previous consultations with the Navy) versus the small number of training events and targets that could be released into the water column and the large habitat area used by ESA-listed fish species in this operation area make it unlikely that these species will encounter expended materials such as targets generated from the gunnery training. We believe the effects of expended gunnery training materials on ESA-listed fish in the Pacific Northwest operation area (Table 6) will be extremely unlikely to occur and therefore not likely to adversely affect these animals.

Gunnery training will also generate noise from the firing of weapons (noise from vessel operations and navigation equipment was already discussed). As noted previously, we do not expect endangered Steller sea lions, Guadalupe fur seals, or leatherback sea turtles to be common in the Pacific Northwest operation area, which is in an offshore area used by the Navy for training and testing activities. If any of these animals are present, they may react to gunnery training by avoiding the area but any avoidance behavior is expected to be minor and temporary as gunnery exercises will last one hour and will use non-explosive rounds. Similarly, while data indicate that some ESA-listed fish species (salmonids and eulachon) may be present in waters on and off the continental shelf in the Pacific Northwest operation area, section 7 consultations with the Navy concluded that only the use of explosives during training activities in the area were likely to result in adverse effects to these species (NMFS 2015b). The peak frequency of gunnery noise is outside the hearing range of ESA-listed sea turtles and fish and these animals are not expected to detect gunnery noise underwater. Therefore, we believe the effects of noise from gunnery training, specifically the firing of non-explosive rounds at a target from the deck of an icebreaker, will be insignificant and thus not likely to adversely affect leatherback sea turtles and ESA-listed fish species in the Pacific Northwest operation area (Table 6).

While gunnery noise may be at a frequency that overlaps with ESA-listed marine mammal hearing for all hearing groups, an animal would have to be surfacing in order for disturbance from gunnery noise to be detectable to the animal (USCG 2017). The activity will take place over an hour, meaning even if whales surface in the area where training is occurring, any disturbance would be temporary. The USCG requires that a lookout be on duty during gunnery training in order to ensure disturbance of marine mammals does not occur. Therefore, we believe the effects of noise from gunnery training on ESA-listed marine mammals in the Pacific Northwest operation area (Table 6) will be insignificant and thus not likely to adversely affect these species.

Environmental response training will take place while the icebreaker is stationary and a small boat operates at three knots to deploy a boom around the vessel to practice containment of a spill. This training will take place twice per year and last three to five hours. If vessels need to anchor during environmental response training, minor impacts to habitat from the deployment of an icebreaker's anchor, such as ephemeral sediment plumes, could occur. However, given the extent of habitat areas used by ESA-listed species in the Pacific Northwest, impacts from anchor deployment would not be expected to result in a significant loss of habitat that could affect species ability to find food, shelter, and breeding habitat. There will be a lookout on the vessel to ensure animals are not trapped within the boom or become entangled in the boom. Given the size of ESA-listed marine mammals, animals would be seen by the lookout prior to any deployment of equipment or if any surface within the area of the boom so that the small vessel could recover the boom quickly to allow the animal to swim away. Therefore, we believe the effects of environmental response training on marine mammals in the Pacific Northwest operation area (Table 6) will be extremely unlikely to occur and thus not likely to result in adverse effects to these animals.

Leatherback sea turtles are uncommon in the Pacific Northwest operation area and so are unlikely to be affected by environmental response training. Training and testing activities conducted by the Navy in the area have not reported impacts to leatherback sea turtles as a result of Navy training and testing in the Pacific Northwest, which occurs much more frequently and with greater intensity than the environmental response training proposed by the USCG for the new icebreakers. Similarly, we do not expect environmental response training to affect ESA-listed fish species in the Pacific Northwest operation area. Training will take place over just a few hours around a single icebreaker. Floating boom is unlikely to pose an entanglement risk for ESA-listed fish because the boom is made of floating material that is completely contained and the only loose lines are those at the ends that will be connected at the icebreaker. Therefore, we believe the effects of environmental response training on leatherback sea turtles and ESA-listed fish in the Pacific Northwest operation area (Table 6) will be extremely unlikely to occur and thus not likely to result in adverse effects to these animals.

Critical habitat is designated for the leatherback sea turtle in two locations along the west coast, one of which stretches from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 m depth contour. The designated areas include waters from the ocean surface to a maximum depth of 262 ft (80 m). The PBF essential for the conservation of leatherback turtles is the occurrence of prey species, primarily scyphomedusae (referred to as true jellyfish), of sufficient condition, distribution, diversity, abundance, and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks. The boundaries of designated critical habitat for leatherback sea turtles off the coasts of Washington and Oregon appear to be just outside the boundary of the Pacific Northwest operation area, but there could be some overlap between training and testing activities that will take place in the Pacific Northwest and leatherback critical habitat. However, we do not expect maneuverability testing, dive team training and operations, gunnery training, or environmental response training to, all of which will take place infrequently and for a few hours to a maximum of two days (in the case of maneuverability testing) to result in changes in the occurrence, distribution, abundance, and availability of preferred prey species for leatherback turtles. Therefore, we do not believe the proposed activities that will take place in the Pacific Northwest operation area will have a measurable effect on leatherback sea turtle designated critical habitat because the effects will be insignificant and not likely to adversely affect this habitat.

### 6.1.3 Activities in the Arctic Operations Area

In the Arctic operation area, activities that are part of the action include icebreaking at full, half, and quarter power; ice condition and bollard condition testing as part of vessel maneuverability testing; vessel escort; passenger and science transfer; law enforcement; SAR training; AUV deployments; diver training and operations; fueling underway; marine environmental response training; and helicopter operations for daytime landing qualifications, ice reconnaissance, law enforcement reconnaissance, vertical replenishment and mission support, and passenger and science transfer. UASs may also be used in the future to perform reconnaissance in support of law enforcement and to look for routes through the ice, though they are not currently used for law enforcement. The potential effects of vessel noise and vessel strikes during transit were analyzed in Section 6.1.1 and will not be discussed again in this section. As noted previously, emergency response activities are not part of this consultation. The ESA-listed species that may be affected by these activities in the Arctic operation area are listed in Table 6.

Icebreaking at full and half power is expected to take place five times per year and at quarter power 11 times per year for 16 hours each time in the Arctic operation area. Ice and bollard condition testing are expected to take place once per decade and will only be conducted in the Arctic operation area. Ice condition testing will take two to six hours and could extend over two days. Ice condition testing involves icebreaking. Bollard condition testing will take two hours to perform and is done while the icebreaker is moored to a pier and operates at full power. Vessel escorts are expected once per year in the Arctic (Table 2) with the potential for an additional escort in the Arctic certain years. Vessel escorts rarely involve escort of multiple vessels at a time. A vessel escort may last up to 24 hours. Icebreaking is part of vessel escort operations. Icebreaking will generate significant noise and may also result in physical impacts to habitat and animals themselves, depending on life history of different species.

Passenger and science transfers are done from icebreakers using support vessels and aircraft. Vessel and helicopter transfers are typically for crew or scientists, though the purpose may vary and helicopter transfers may be associated with outreach activities as well. Transfers using support vessels are conducted when the icebreaker is no more than 10 to 12 nm from shore, take up to 12 hours for support vessels to leave and return, and are conducted approximately five times per year, though this varies with the number of science missions and other needs in a given year. Similarly, law enforcement activities involve the use of a support vessel operating within a mile of the icebreaker at speeds up to 30 knots. Law enforcement activities will only take place in the Arctic operation area and largely involve interventions with fishing vessels. Up to 20 law enforcement actions are expected each year lasting up to 12 hours each. These activities involving support vessels could lead to collisions with ESA-listed species in the Arctic operation area. The effects of potential collisions on ESA-listed species were discussed in Section 6.1.1; thus, transfers and law enforcement activities will not be discussed further.

Passenger and science transfers using helicopters are expected to occur four times per year and last two to four hours for the helicopter to leave and return to the icebreaker. Helicopters will also be used for vertical replenishment and other mission support twice per year for up to 6 hours each time. Helicopters will operate at an altitude of 1,500 ft or more when conducting transfers and mission support. Helicopters will fly at altitudes of 500 to 1,000 ft during vertical replenishments, though the route selected will attempt to avoid protected areas, critical habitat, haulouts, rookeries, and other areas where marine mammals may congregate. Helicopters are expected to operate in the immediate vicinity of an icebreaker during deck landing qualifications. There will be a landing qualification conducted each month while vessels are on patrol so the number of qualifications per patrol and per year will depend on the number of months a vessel is deployed in the Arctic. Landing qualifications require 15 takeoffs and landings over the course of four hours and a quarter of these are done at night.

Aircraft are also used for SAR training and ice reconnaissance. SAR training may involve the use of more than one helicopter operating for up to 12 hours. A support vessel may also be used during training activities and crew may also practice responses to provide support to a stranded vessel. SAR training will occur once per year in the Arctic operation area. A helicopter or UAS will be used to perform ice reconnaissance twice in the Arctic per year for two hours. The low frequency noise associated with aircraft operation can be heard by ESA-listed sea turtles, fish, and marine mammals. Helicopters and UASs used for ice reconnaissance and helicopters used during SAR training may fly at lower altitudes but would follow PDCs when possible.

An AUV may also be placed in the water for ice reconnaissance while an icebreaker is stationary or moving at a speed of three knots. The AUV will operate at speeds up to 10 knots underwater. AUVs will be deployed twice per patrol in the Arctic (expected that each icebreaker will perform two patrols per year) for up to 24 hours. The AUV does not use sonar and is not expected to generate significant noise but could collide with animals or cause disturbance when animals see the AUV. AUVs typically have collision avoidance technology and ESA-listed species are expected to swim away from the instrument if disturbed.

Environmental response training in the Arctic operation area will be as described for the activity in the Pacific Northwest operation area (Section 6.1.2). Dive team training will also be as described in Section 6.1.2 but training will occur more frequently with two training events per deep freeze while the icebreaker is in ice and 2 training events per patrol during science missions, meaning that dive training while the icebreaker is operating in the Arctic will not take place only while the vessel is in port. As described in Section 6.1.2, dive operations will occur only on an as-needed basis per patrol and while the vessel is in a port or moored to a pier.

Fueling underway is an activity that involves an icebreaker and a fuel vessel, both of which remain stationary, with fuel lines connecting the vessels in order refuel the icebreaker. This type of refueling is expected to occur once every five years and requires three hours to complete. Accidental spills while refueling could affect ESA-listed species in the Arctic operation area, though the requirement that vessels have spill plans and equipment to quickly respond to and clean up spills will minimize the potential effects of accidental spills.

The activities that will take place in the Arctic operation area will result in 96 hours of AUV use per year (assuming two patrols per year at 48 hours per patrol); 60 hours of icebreaker and small boat operations for passenger transfer; up to 72 hours of vessel escort that includes icebreaking; up to 336 hours of icebreaking at full, half, and quarter power; up to 12 hours of ice condition testing (icebreaking) although this will only take place once every 10 years; 2 hours of bollard condition testing (at a pier) which will also only take place once every 10 years; and 60 hours of helicopter operation (though 4 hours of this could be UAS operation) per year. The icebreaker and small boats would be used at any time during each 80-day patrol, including for transit and law enforcement and training activities. Each patrol, including transit, these vessels may be used for approximately 1,920 hours. There will be additional hours of icebreaker operation associated with transit to and from homeport and operation areas, as well as time spent in ports resupplying, fueling, and/or picking up crew and gear. There are several ESA-listed marine mammal species for which the effects of stressors associated with the proposed activities, particularly those involving icebreaking, are likely to be adverse and these animals (bowhead, fin, and humpback whales; ringed and bearded seals) are discussed in more detail beginning in Section 6.2. The rest of the ESA-listed species present in the Arctic operation area identified in Table 6 are discussed in more detail below. Stressors from the activities proposed in the Arctic operation area are expected to have a minimal effect on the animals discussed in this section because they are rare in this operation area, are present only seasonally, and are not expected to be concentrated in areas where icebreaking activities will take place.

Leatherback sea turtles are wide-ranging and cold-tolerant with non-breeding turtles seen at high latitudes. McAlpine et al. (2004) suggested that the occurrence of leatherbacks off British Columbia, which is most frequent from July to September, indicates the species is an uncommon seasonal resident of the area. The occurrence of leatherback sea turtles in Alaska suggests that they are ranging into marginal habitat (Hodge and Wing 2000). Approximately 19 leatherback sea turtles have been recorded in Alaska since the 1960s (Hodge and Wing 2000). Because of the infrequent occurrence of leatherback sea turtles in the Arctic operation area, exposure to stressors resulting from the activities that will be carried out in the Arctic operation area by the new icebreakers and associated small vessels, AUVs, helicopters, and UASs, will be extremely unlikely to occur and therefore extremely unlikely to occur. Thus, activities in the Arctic operation area associated with the action are not likely to adversely affect leatherback sea turtles.

ESA-listed salmonids may be present in Alaska waters as juveniles or adults after their spawning, egg development, and larval stages are completed in freshwater streams of

Washington, Oregon, California, and/or Idaho, depending on the species and ESU. Specifically, the Lower Columbia River and Upper Willamette River ESUs of chinook salmon have been reported as bycatch in the groundfish fishery (targeting pollock) in the Bering Sea (Stram and Ianelli 2009) and Lower Columbia River coho salman occur in the Bering and Chukchi Sea. It is possible that Columbia River chum are also present in portions of the Bering Sea based on foraging habits of other salmon species. Relative to the total number of salmonids caught in Bering Sea fisheries, the numbers of animals from ESA-listed ESUs is very small and there are plans in place to minimize bycatch of listed ESUs (Stram and Ianelli 2009). Green sturgeon Southern DPS are found in southern Alaska waters and may be present in the Bering Sea, based on reports of the Northern and Southern DPSs in the Bering Sea.

ESA-listed fish are not expected to be present in areas where icebreaking activities will occur. Other activities that will take place while vessels are on patrol, such as passenger transfer and landing qualifications, are also not likely to occur in areas with ESA-listed fish species. If any ESA-listed fish species are present during activities in the Arctic operation area as part of the action, the short-term temporary nature of the training and other activities are not likely to result in significant disturbance and associated behavioral changes on the part of the fish. Vessel collisions with fish are also rare and typicaly reported in confined water bodies such as rivers where species like sturgeon occur. Because the green sturgeon Southern DPS is rare in the Bering Sea, it is unlikely the icebreakers would encounter these animals. Similarly, because the number of ESA-listed salmonids present in the Bering Sea is likely to be low based on fishery bycatch data, it is unlikely the icebreakers would encounter these animals. Therefore, exposure to stressors resulting from the activities that will be carried out in the Arctic operation area by the new icebreakers and associated small vessels, AUVs, helicopters, and UASs, will be extremely unlikely to occur and therefore extremely unlikely to occur. Thus, activities in the Arctic operation area associated with the action are not likely to adversely affect ESA-listed fish species.

Western North Pacific gray whales range as far north as the Bering Sea and some individuals, confirmed by genetic testing (Bruniche-Olsen et al. 2018), transit the Bering Sea and northern Gulf of Alaska to coastal British Columbia, Washington, and Oregon during the winter (Mate et al. 2011; Weller et al. 2012). Gray whales use the nearshore areas of the Alaska Peninsula during the spring and fall migrations and are often found within the bays and lagoons, primarily north of the peninsula, during the summer (Navy 2006). Western North Pacific gray whales are not common in U.S. waters and are observed more frequently in waters off Russia, Korea, and Japan. Because of the extremely low numbers of Western North Pacific gray whales in U.S. waters and their rare occurrence in the Gulf of Alaska, Bering Sea, and Aleutian Islands, exposure to stressors resulting from the activities that will be carried out in the Arctic operation area by the new icebreakers and associated small vessels, AUVs, helicopters, and UASs, will be extremely unlikely to occur and therefore extremely unlikely to occur. Thus, activities in the Arctic operation area associated with the action are not likely to adversely affect Western North Pacific gray whales.

Southern Resident killer whales have different ranges depending on the time of year. During the spring, summer, and fall their range includes the inland waterways of Washington State and the transboundary waters between the United States and Canada. In recent years, they have been spotted as far south as central California and as far north as Southeast Alaska during the winter months (USCG 2019). The range of Southern Resident killer whales is not expected to overlap with the Arctic operation area, which is in more northern waters. If a Southern Resident killer whale were to enter the Arctic operation area, it would not be in an area where icebreaking and other activities expected to result in acoustic effects to listed species will take place. Southern Resident killer whales are more likely to be present in areas where icebreakers are transiting from their expected homeport in Seattle, Washington, which is discussed in more detail in Section 6.1.5. Because Southern Resident killer whales are rare in waters off Alaska, particularly outside Southeast Alaska, exposure to stressors resulting from the activities that will be carried out in the Arctic operation area by the new icebreakers and associated small vessels, AUVs, helicopters, and UASs, will be extremely unlikely to occur and therefore extremely unlikely to occur. Thus, activities in the Arctic operation area associated with the action are not likely to adversely affect Southern Resident killer whales.

Since 1980, North Pacific right whales have been observed singly or in small groups south of Kodiak, in on-shelf and mid-slope waters in the Gulf of Alaska, near Unimak Pass in the Aleutian Islands, and on the mid-shelf of the Bering Sea (Shelden et al. 2005; Zerbini et al. 2010; Wade et al. 2011). Passive acoustic monitoring from 2011 to 2014 detected possible North Pacific right whale calls in the northern Bering Sea during winter months, suggesting they occur further north later in the season than previously known (Muto et al. 2017b). An individual was visually identified north of St. Lawrence Island (northern Bering Sea) in November 2012 (Muto et al. 2017b). Areas where icebreaking will occur within the Arctic operation area, which are the activities most likely to result in disturbance of marine mammals, are outside most of the locations in the Bering Sea where North Pacific right whales are likely to be present during their winter migration. Other activities, such as the use of helicopters to resupply are also proposed in locations outside areas where this species is more likely to be present. In addition, the USCG's SOPs require the use of a lookout to search for marine mammals while icebreakers are in operation and the avoidance of critical habitats and other areas where ESA-listed species concentrate. As stated in the designation of critical habitat for this species, North Pacific right whales are considered rare north of 60$^{o}$N latitude and reported sightings north of this latitude are likely to have been misidentifications of bowhead whales (73 FR 19000). We believe exposure of North Pacific right whale to stressors resulting from activities that will be carried out in the Arctic operation area will be extremely unlikely and therefore extremely unlikely to occur. Thus, activities in the Arctic operation area associated with the action are not likely to adversely affect North Pacific right whales.

North Pacific right whale critical habitat includes an area in the southeastern Bering Sea and another south of Kodiak Island where high concentrations of zooplankton and sightings of North Pacific right whales are relatively common. The primary constituent element of this critical habitat is the presence of large aggregations of zooplankton in areas where the North Pacific right whale is known or believed to feed. The area designated in the Bering Sea is within the boundaries of the Arctic operation area but is outside the locations where icebreaking activities will occur, which would be the activities most likely to disturb copepods and other important prey items through noise generated by icebreaking activities. None of the other activities, all of which will be short-term and temporary in nature and involve the use of one icebreaker and a limited number of support vessels or helicopters/UASs are expected to result in changes in the density, distribution, or condition of zooplankton species used by North Pacific right whales in the designated critical habitat for this species in the Bering Sea. Therefore, we believe the effects of exposure to stressors associated with the action to the PBFs for North Pacific right whale critical habitat will be insignificant and thus not likely to adversely affect the portion of critical habitat in the Bering Sea. No effect to the other designated critical habitat area near Kodiak Island is expected to occur as a result of the action from icebreakers transiting in this area if they were to use a port in the Gulf of Alaska.

In the North Pacific, the northernmost boundary for sperm whales extends from Cape Navarin, Russia (latitude 62º N) to the Pribilof Islands, Alaska (Omura 1955; Allen and Angliss 2014b). Sperm whales have been observed in the Gulf of Alaska, Bering Sea, and around the Aleutian Islands (Muto et al. 2017b). Sperm whales occur year-round in the Gulf of Alaska, but appear to be more common during the summer months than the winter months based on data from acoustic surveys (Mellinger et al. 2004). NMFS Marine Mammal Lab researchers found sperm whales to be the most frequently observed large cetaceans in coastal waters around the central and western Aleutian Islands during the summer months (Muto et al. 2017b). In the North Pacific Ocean, sei whales have been reported to occur mainly south of the Aleutian Islands (Leatherwood 1988; Nasu 1974). Although Japanese sighting records reported sei whales in the northern and western Bering Sea from July through September (Masaki 1977), the Japanese sighting data have never been confirmed (NMFS 2011b). Given the locations where sperm and sei whales are common versus the locations where the proposed activities with the new icebreakers will be conducted in the Arctic operation area, we believe that, similar to North Pacific right whale, sperm and sei whales are extremely unlikely to be exposed to stressors resulting from these activities. Therefore effects will be extremely unlikely to occur and activities in the Arctic operation area associated with the action are not likely to adversely affect sperm and sei whales.

Blue whales are rare in Alaska waters with a sighting in 2004 being the first after 30 years of no visual observations of this species in Alaska, though numbers are increasing after being nearly hunted to extinction. More recent passive acoustic monitoring as part of cetacean research have identified blue whale calls in the eastern tropical Pacific through the Gulf of Alaska and off of Hawaii, Midway Island, in the Northwest Pacific, and Alaska. While NMFS recognizes two stocks under the MMPA (Eastern and Western North Pacific), because calls from both stocks are mixed in Alaska waters, some researchers believe the stocks may not be distinct and the International Whaling Commission (IWC) recognizes a single North Pacific stock. Blue whales are sometimes observed in the Bering Sea, particularly around the Aleutian Islands, which are outside the Arctic operation area. Therefore, because of the rarity of this species in waters within the Arctic operation area, blue whales are unlikely to interact with icebreakers engaged in the activities proposed for the Arctic operation area. As for North Pacific right whales, sperm whales, and sei whales, we believe blue whales are extremely unlikely to be exposed to stressors associated with the action in the Arctic operation area. Therefore, effects will be extremely unlikely to occur and USCG activities in the Arctic operation area are not likely to adversely affect blue whales.

Steller sea lions from the Western DPS generally occur west of Cape Suckling, Alaska, and individuals may widely disperse outside the breeding season, which is late May to early July (Muto et al. 2017b). Several rookeries and haulouts used by Steller sea lions and designated as critical habitat for the species are within the Arctic operation area. Steller sea lion critical habitat was designated as a 20 nm buffer around all major haulouts and rookeries; associated terrestrial, air, and aquatic zones; and three large offshore foraging areas in Alaska. Steller sea lions may haul out on sea ice, particularly in the Bering and Okhotsk Sea, but their haulouts and rookeries usually consist of gravel, rocky, or sandy beaches, ledges, and rocky reefs. Rookeries where Steller sea lions mate and give birth are all on land. Unlike ice seals, Steller sea lions are not expected to be present where icebreaking activities will occur. Steller sea lion designated critical habitat is also not within areas where icebreaking will occur. The operation of icebreakers and associated support vessels and aircraft for activities that are not associated with icebreaking, including vessel transit, are expected to overlap with the animals. The PDCs for aircraft operations (Section 3.3.1), which are based on USCG SOPs, require that aircraft operate at an altitiude of 2,000 ft (610 m) above sensitive habitat areas such as known haulouts or rookeries. For UASs, USCG must comply with Federal Aviation Administration requirements to fly small UASs below 400 ft (122 m), but will not operate them within 1,000 ft (305 m) in any direction of a marine mammal. Studies such as that by Christiansen et al. (2016) indicate that UAS noise is close to ambient noise levels in water and, though it can be heard by baleen whales and pinnipeds based on their hearing ranges, does not appear to disturb animals in water based on observations of their behavior, although there have been observations of humpback whales changing their behavior in response to low-flying drones (MMPA Permit No. 18636). On land, UASs may lead to behavioral reactions on the part of pinnipeds ranging from mild responses such as raising their heads to look at the UAS to more obvious responses such as fleeing into the water. Because UASs will not be hovering in areas with concentrations of pinnipeds on land or in water, any behavioral response to disturbance will be very short, with animals expected to quickly return to normal behavior.

Small vessels and icebreakers have lookouts dedicated to searching for animals in the water to minimize the potential for disturbance of animals during activities such as training exercises and vessel collisions. Bollard testing, which will occur once per decade, could result in significant disturbance to Steller sea lions because the icebreaker will operate at full power for two hours. However, this testing will occur while the vessel is moored to a pier and would not take place in areas containing designated critical habitat. Animals would be expected to avoid the pier where the vessel is moored during testing due to noise and lookouts would search for animals prior to commencing testing to minimize the potential for them to be disturbed by the noise. Given the infrequent disturbance (with icebreakers patrolling over several months during a couple of deployments in the Arctic per year and training and other activities occurring over periods of hours), we believe the effects of the proposed USCG activities in the Arctic operation area on Steller sea lions will be extremely unlikely to occur and therefore not likely to adversely affect the Western DPS of this species. Similarly, we believe the proposed activities will not alter the function of designated critical habitat, particularly those rookeries and haulouts present in the Bering Sea, and exposure to stressors associated with the proposed activities will therefore be extremely unlikely to occur. Thus, the action is not likely to adversely affect designated critical habitat for the Western DPS Steller sea lion.

### 6.1.4 Activities in the Antarctic Operations Area

In the Antarctic operation area, activities that are part of the action include icebreaking at full and quarter power; vessel escort; vessel tow; passenger and science transfer; search and rescue training; diver training and operations; fueling underway; and helicopter operations for daytime landing qualifications, ice reconnaissance using a UAS, vertical replenishment and mission support, and passenger and science transfer.

Icebreaking at full power is expected to take place 4 times per year and at quarter power 22 times per year for 16 hours each time in the Antarctic operation area. Vessel escorts are expected two times per year and vessel towing once per year in the Antarctic. A vessel escort typically lasts up to 16 hours, but an additional 48 hours of vessel escort could occur in the Arctic or Antarctic. A vessel tow typically lasts 1 to 48 hours, depending on the distance. Icebreaking is part of vessel escort and towing operations. Icebreaking will generate significant noise and may also result in physical impacts to habitat and animals themselves, depending on life history of different species.

Passenger and science transfers will be done using support vessels and aircraft. Transfers using support vessels take up to 12 hours for support vessels to leave and return, and are conducted approximately four times per year, though this varies with the number of science missions and other needs in a given year. Activities involving support vessels could lead to collisions with ESA-listed species in the Antarctic operation area. The effects of potential collisions on ESA-listed species were discussed in Section 6.1.1; thus, transfers will not be discussed further.

Passenger and science transfers using helicopters are expected to occur four times per year and last two to four hours for the helicopter to leave and return to the icebreaker. Helicopters will also be used for vertical replenishment and other mission support once per year for up to 6 hours. Helicopters will operate at an altitude of 1,500 ft or more when conducting transfers and mission support. Helicopters will operate at lower altitudes (500 to 1,000 ft) when conducting vertical replenishment. Helicopters are expected to operate in the immediate vicinity of a icebreaker during landing qualifications. There will be a landing qualification conducted each month while vessels are on patrol so the number of qualifications per patrol and per year will depend on the number of months a vessel is deployed in the Antarctic. Landing qualifications require 15 takeoffs and landings over the course of 4 hours and a quarter of these are done at night.

Aircraft are also used for SAR training and ice reconnaissance. SAR training may involve the use of more than one helicopter operating for up to 12 hours. A support vessel may also be used during training activities and crew may also practice responses to provide support to a stranded vessel. SAR training will occur once per year in the Antarctic operation area. A helicopter or UAS will be used to perform ice reconnaissance twice in the Antarctic per year for two hours. The low frequency noise associated with aircraft operation can be heard by ESA-listed whales. Helicopters and UASs used for ice reconnaissance and helicopters used during SAR training may fly at lower altitudes, which may lead to disturbance of animals that see and hear the aircraft.

Dive team training will be as described in Section 6.1.2 but training will occur more frequently with two training events per deep freeze while the icebreaker is in ice and two training events per patrol during science missions, meaning that dive training while the icebreaker is operating in the Antarctic will not take place only while the vessel is in port. As described in Section 6.1.2, dive operations will occur only on an as-needed basis per patrol and while the vessel is in a port or moored to a pier.

Fueling underway is an activity that involves an icebreaker and a fuel vessel, both of which remain stationary, with fuel lines connecting the vessels in order refuel the icebreaker. This type of refueling is expected to occur once every five years and requires three hours to complete. Accidental spills while refueling could affect ESA-listed species in the Arctic operation area, though the requirement that vessels have spill plans and equipment to quickly respond to and clean up spills will minimize the potential effects of accidental spills.

The activities that will take place in the Antarctic operation area will result in 48  hours of icebreaker and small boat operations for passenger transfer; up to 80 hours of vessel escort and 48 hours of vessel tow that may include icebreaking; up to 416 hours of icebreaking at full and quarter power; and up to 44 hours of helicopter operation (though four hours of this could be UAS operation) per year. The icebreaker and small boats would be used at any time during each 4.5-month patrol, including for transit and training activities. There will be additional hours of icebreaker operation associated with transit to and from homeport and operation areas. There may also be towing of the ice pier from McMurdo station to open waters, although, as discussed in Section 3.2.2.3 information provided by NSF indicates that the ice pier has been breaking off naturally and no icebreaker towing has been required for years.

In Table 6, we identify blue, fin (discussed in Section 8), sperm, Southern right, and sei whales as the species in the Antarctic operation area based on consultations we have conducted for studies in the Ross Sea. The information in our files indicates that these whales are not in the immediate area of McMurdo station where icebreaking and vessel escort and tow activities, which also require icebreaking, are proposed in the Antarctic operation area. Therefore, it may be that these whales will only be encountered by icebreakers while in transit to this operation area rather than within the operation area.

During the austral summer, blue whales range from the edge of the Antarctic pack ice (40 to 78ºS latitude), and north to Ecuador, Brazil, South Africa, Australia, and New Zealand during the austral winter (Shirihai 2002). Blue whales seem to be most common in Antarctic waters from February to May, as well as in November (Gedamke and Robinson 2010; Sirovic et al. 2009) with blue whales particularly numerous and/or vocal north of Prydz Bay, Antarctica based on sonobuoy deployments (Gedamke and Robinson 2010).

Sperm whales in the Southern Hemisphere are treated as a single stock with nine divisions, based more on whaling records than biological differences (Donovan 1991). Sperm whales off the Galapagos Islands, mainland Ecuador, and northern Peru may be distinct from other sperm whales in the Southern Hemisphere (Dufault and Whitehead 1995; Rice 1977; Wade and Gerrodette 1993). Gaskin (1973) found females were absent in waters south of 50ºS and decrease in proportion to males south of 46 to 47ºS. Populations of sperm whales in the Ross Sea are estimated to range between 88 (Ensor et al. 2004) and 800 animals (Pinkerton et al. 2010).

Southern right whales are found between 18 to 55ºS and migrate between feeding grounds in Antarctic waters in austral summer and breeding grounds closer to the equator (Australia, South Africa) in austral winter. This species is reported as a commonly observed species by tour operators that take people to Antarctica.

Sei whales occur throughout the Southern Ocean during the austral summer, generally between 40 and 50ºS (Gambell 1985b). During the austral winter, sei whales occur off Brazil and the western and eastern coasts of Southern Africa and Australia. Sei whales generally do not occur north of 30ºS in the Southern Hemisphere (Reeves et al. 1999), although confirmed sighting records exist for Papua New Guinea and New Caledonia with unconfirmed sightings in the Cook Islands (NMFS 2011b).

All of the activities proposed in the Antarctic operation area will take place during the austral summer, which is when ESA-listed whales will be present in the action area when they use waters in the Ross Sea as feeding grounds. Based on a review of previous consultations, these whale species are likely to be in areas of the Ross Sea where prey concentrate, which includes areas along the ice edge, but are not expected to be common in the immediate vicinity of the Antarctica operation area, particularly McMurdo Station. Other activities such as vessel escort and tow will occur in the area of McMurdo Station in order to move vessels to and from the pier using icebreaking. Previous consultations have determined that icebreaking activities associated with seismic surveys in the Ross Sea would result in temporary behavioral effects to blue, fin, sei, humpback, and sperm whales (Southern right whales were not considered in the consultations), specifically the movement of these animals out of the area where icebreaking and seismic surveys were occurring (see, for instance, NMFS 2015a). The use of support vessels and aircraft during other activities such as passenger transfers could also result in temporary disturbance of ESA-listed whales. It is important to note that the total time in terms of both number per year and hours per activity are worst case estimates provided by the USCG and some years there may be less likelihood of disturbance depending on the extent of sea ice and other factors such as the number of scientific operations requiring support. The temporary disturbance of ESA-listed whales that may be in the Antarctic operation area is expected to lead to whales moving out of the area where icebreaking and other activities are occurring to other portions of the Ross Sea. This would result in temporary suspension of feeding and other behaviors but, given the extent of habitat available to whales and the apparent prefence of these animals for areas along borders of the Ross Ice Shelf, we expect any effects from exposure of these stressors to be unlikely and therefore extremely unlikely to occur. Therefore, the action is not likely to adversely affect blue, sperm, Southern right, and sei whales in the Antarctic operation area.

#### 6.1.5 Expected Homeport

As noted previously, Seattle, Washington is the current homeport for the existing polar icebreakers and is the expected homeport for the new icebreakers. If a different homeport is selected, reinitiation of consultation may be necessary if exposure to the stressors associated with operation of icebreakers in the homeport would result in adverse effects to ESA-listed species or designated critical habitat or potential stressors, species, or overlap that was not analyzed in this consultation.

Seattle is in Puget Sound, an estuarine system connected to the Pacific Ocean. Puget Sound is one of several water bodies north of Olympia, Washington, south of Canda, and around Vancouver Island (Washington). The other water bodies include the Strait of Juan de Fuca, the Strait of Georgia, waters surrounding the San Juan Islands, and Hood Canal. The dredged Admirality Inlet in Puget Sound connecting to the Strait of Juan de Fuca  provides the only route for deep draft vessels exiting or entering Puget Sound.

Exposure to stressors from vessel operation, including noise from transit and the use of navigation equipment, and vessel strike were discussed in Section 6.1.1. We do not anticipate the effects of exposure would be different for ESA-listed fish species but we do include a more detailed discussion of the potential effects of vessel strike on Southern Resident killer whales in this section.

Dive operations and training involving activities such as ship husbandry and placement of cofferdams on the hull of the vessel as part of vessel maintenance would occur while the new icebreakers are in port. Dive training is expected to occur once per month and dive operations could occur more or less frequently, depending on need. These activities could result in impacts to water and sediment quality from the release of contaminants and impacts to habitat and animals themselves from the release of debris. Ship husbandry will be regulated under the new UNDS Phase II Batch Two rule, expected to be promulgated in the spring of 2019. Even without the rule, the USCG has SOPs in place to minimize the release of materials into water bodies, except in accordance with regulations. Materials from the temporary placement of a cofferdam on the vessel’s hull and subsequent removal could also be released into surrounding waters. However, because this work will be done with divers, it is expected they will collect the cofferdam in its entirety or recover pieces that break and fall into the water. Other discharges into waters surrounding the icebreakers include accidental spills and lubricants and other petroleum products from motors. Water quality in Puget Sound is affected by industrial and urban land use in this heavily developed area. The Puget Sound, Seattle area is the homeport for 337 vessels of the Armed Forces, including the USCG (USEPA and Navy 2018). Therefore, any discharges resulting from infrequent activities associated with icebreaker maintenance, operation, and personnel training would not be separable from background conditions in the area. In addition, SOPs and regulations requiring that discharges to waters be minimized would prevent large releases of contaminants, including required spill response plans and equipment.

In spring and summer months, Southern Resident killer whales are frequently seen in the San Juan Islands region with intermittent sightings in Puget Sound (Whale Museum 2012). In the fall and early winter months, Southern Resident killer whales are seen more frequently in Puget Sound, where returning chum and chinook salmon are concentrated (Osborne et al. 1988). In winter, they spend progressively less time in the inland marine waters and more time off the coast of Washington, Oregon, and California (Black 2011). Southern Resident killer whales have not been reported in Hood Canal or Dabob Bay since 1995 according to NMFS (2008b). Southern resident killer whales (J pod) were historically documented in Hood Canal by sound recordings in 1958 (Ford and Morton 1991), a photograph from 1973, and anecdotal accounts of historical use, but the latter sightings may be transient whales (NMFS 2008b). Transients and Southern Resident killer whales have been observed in southern Puget Sound in the Carr Inlet area (NMFS 2015b). Southern Resident killer whales are not observed frequently near existing Naval bases, which are also in the area where the USCG has its homeport. While commercial and recreational boat traffic and ferry operations have increased in Puget Sound and other areas along the coast of the Pacific Northwest since the 1970s, vessel collisions with these animals are infrequent. In 2005, a Southern Resident killer whale was injured in a collision with a commercial whale watch vessel although the whale subsequently recovered from those injuries. In 2006, an adult male Southern Resident killer whale, L98, was killed in a collision with a tug boat (NMFS 2015b). Despite the level of military vessel activity in the Puget Sound, Seattle area, collisions with military vessels have not been reported. We believe the potential for exposure stressors such as vessel collisions and others associated with the use of Seattle as a homeport for the new icebreakers is low given the infrequent vessel collisions with these animals in the area, lack of data indicating military vessels have struck these animals, and low frequency of occurrence of these animals in the area where the icebreakers would homeport. Therefore, the effects of the use of Seattle as the homeport for the new icebreakers would be extremely unlikely to occur and thus not likely to adversely affect Southern Resident killer whales.

Green sturgeon are not known to spawn in any rivers of Puget Sound and few green sturgeon have been found in Puget Sound, with only two confirmed observations in 2006 (NMFS 2012). Critical habitat for the Southern DPS of green sturgeon is designated in coastal waters up to 60 fathoms deep in areas including the Strait of Juan de Fuca. Critical habitat in freshwater riverine systems includes food resources and migratory corridors for adult spawning, development of embryos and larvae, and juvenile growth and development, but is only designated for rivers in California. Critical habitat in estuarine areas includes food resources and migratory corridors for juvenile growth and seaward migration, subadult growth and movement between estuarine and marine areas, and adult growth and movement including for spawning and post-spawning. The use of Puget Sound, Seattle as a homeport for the new icebreakers will not involve freshwater habitat and is not expected to result in measurable changes in water quality, depth, flow, sediment quality, migration corridors, or food resources of green sturgeon. We believe exposure to stressors associated with homeporting of the new icebreakers will be extremely unlikely and therefore extremely unlikely to occur. Therefore, the use of Seattle as a homeport is not likely to adversely affect the Southern DPS of green sturgeon or its designated critical habitat.

Designated critical habitat for yelloweye rockfish (Puget Sound/Georgia Basin DPS) and bocaccio (Puget Sound/Georgia Basin DPS) includes 590.4 square miles ($mi^2$) of nearshore habitat for bocaccio and 414.1 $mi^2$ of deepwater habitat for yelloweye rockfish and bocaccio in Puget Sound/Georgia Basin. PBFs for deepwater critical habitat includes habitat supporting feeding opportunities and predator avoidance, water quality and dissolved oxygen to support the fish and their prey, and availability of prey. Nearshore habitats provide areas for juvenile settlement and growth and PBFs include water quality and dissolved oxygen to support the fish and their prey and availabity of prey. The final rule designating critical habitat excluded marine habitats occupied by yelloweye rockfish that are in areas with military bases. Activities associated with the use of Seattle as a homeport are unlikely to directly affect yelloweye rockfish and bocaccio, but could have effects on these species through habitat degradation. However, as noted previously, icebreakers will be located in an area with existing military and other operations and habitat in this area was excluded from the critical habitat designation. Impacts to habitat and subsequently, yelloweye rockfish and bocaccio associated with the use of the area as a homeport for the new icebreakers are not expected to be measureable and would therefore be insignificant. Thus, the use of Seattle as a homeport is not likely to adversely affect the Puget Sound/Georgia Basin DPS of yelloweye rockfish and bocaccio or their designated critical habitat.

Designated critical habitat for Puget Sound chinook salmon includes portions of the Nooksack River, Skagit River, Sauk River, Stillaguamish River, Skykomish River, Snoqualmie River, Lake Washington, Green River, Puyallup River, White River, Nisqually River, Hamma Hamma River and other Hood Canal watersheds; the Dungeness/Elwha watershed; and nearshore marine areas of the Strait of Georgia, Puget Sound, Hood Canal, and the Strait of Juan de Fuca. Designated critical habitat for Puget Sound steelhead is almost identical to that designated for chinook salmon. Differences include the Bellingham Bay, Samish River, and Birch Bay watersheds within the Strait of Georgia Basin; Pilchuck River within the Snohomish Basin; and Green River in the Duwamish Basin stream miles for steelhead DPS that are not part of chinook salmon designated critical habitat for the Puget Sound ESU. Essential features of these critical habitats include sites necessary to support one or more life stages. These include estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult food resources, including aquatic invertebrates and fishes, supporting growth and maturation. Activities associated with use of Seattle as the homeport for the new icebreakers is not expected to cause measurable changes in food resources, water quality or quantity, or natural cover in designated critical habitat for Puget Sound chinook salmon and steelhead.

The geographic areas included in the designated critical habitat for Hood Canal summer-run chum salmon are the Skokomish River; Hood Canal subbasin, including the Hamma Hamma and Dosewallips River and others; the Puget Sound subbasin; Dungeness/Elwha subbasin, and nearshore marine areas of Hood Canal and the Strait of Juan de Fuca from the line of extreme high tide to a depth of 30 m. As for other ESA-listed fish species discussed in this section, critical habitat includes freshwater, estuarine, and marine habitats supporting various life stages and providing habitat for prey and protection from predators. Activities associated with use of Seattle as the homeport for the new icebreakers is not expected to cause measurable changes in food resources, water quality or quantity, or natural cover in designated critical habitat for Hood Canal summer-run chum salmon.

In addition to designated critical habitat, all ESA-listed ESUs of chinook, coho, chum, and sockeye salmon, and all DPSs of steelhead trout may be found in the Puget Sound area where the new icebreakers are expected to homeport. Direct effects to these fish species are not expected as a result of the proposed homeporting of the new icebreakers. Effects, such as impacts to habitat (whether designated critical habitat or not) could occur as a result of discharges from icebreakers during routine maintenance activities, accidental spills, or regular operations (because motors often release small amounts of petroleum products like lubricating oils and fuel). However, as for other fish species and critical habitat discussed in this section, we do not expect the effects of the use of Seattle as a homeport for the new icebreakers to result in measureable effects to ESA-listed salmonids or any designated critical habitat for these species because the effects would be minor, temporary, and not alter water quality parameters to an extent that could be quanitified. Therefore, we believe any effects would be insignificant and thus not likely to result in adverse effects to any all ESA-listed ESUs of chinook, coho, chum, and sockeye salmon, or DPSs of steelhead trout, designated critical habitat for Puget Sound chinook salmon or steelhead trout, or designated critical habitat for Hood Canal summer-run chum salmon.

## 6.2 Status of Species and Critical Habitat Likely to be Adversely Affected

This Opinion examines the status of fin, bowhead, and humpback (Western North Pacific and Mexico DPSs) whales; ringed (Arctic subspecies) and bearded seals (Beringia DPS); and proposed critical habitat for the Arctic subspecies of ringed seals that may be affected by the action.

The evaluation of adverse effects in this Opinion begins by summarizing the biology and ecology of those species that are likely to be adversely affected and what is known about their life histories in the action area and the condition of designated critical habitat within the applicable critical habitat unit and in the action area. The status is determined by the level of risk that the

ESA-listed species and designated critical habitat face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This helps to inform the description of the species' current "reproduction, numbers or distribution" that is part of the jeopardy determination as described in 50 CFR §402.02. This section also examines the condition of critical habitat throughout the designated area (such as various watersheds and coastal and marine environments that make up the designated area), and discusses the condition and current function of designated or proposed critical habitat, including the essential physical and biological features that contribute to that conservation value of the critical habitat. More detailed information on the status and trends of these ESA-listed species, and their biology and ecology can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on the NMFS Web site: [https://www.fisheries.noaa.gov/topic/endangered-species-conservation].

### 6.2.1 Fin Whale

The fin whale is a large, widely distributed baleen whale found in all major oceans and comprised of three subspecies: *B. p. physalus* in the Northern Hemisphere, and *B. p. quoyi* and *B. p. patachonica* (a pygmy form) in the Southern Hemisphere (Figure 5).

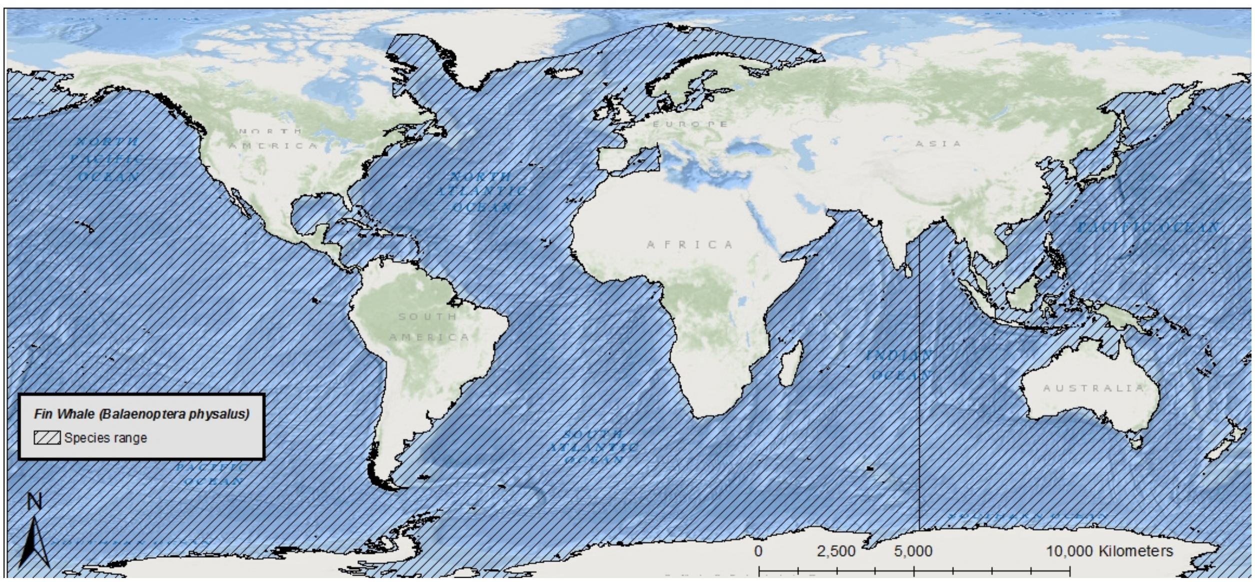


**Figure 5: Map identifying the range of the fin whale.**

Fin whales are distinguishable from other whales by a sleek, streamlined body with a V-shaped head, a tall, falcate dorsal fin, and a distinctive color pattern of a black or dark brownish-gray body and sides with a white ventral surface. The fin whale was originally listed as endangered on December 2, 1970.

Information available from the recovery plan (NMFS 2010), recent stock assessment reports (Carretta et al. 2017; Hayes et al. 2017b; Muto et al. 2017a), and the status review (NMFS 2011a) were used to summarize the life history, population dynamics, and status of the species as follows.

*Life History*

Fin whales can live, on average, 80 to 90 years. They have a gestation period of less than one year, and calves nurse for six to seven months. Sexual maturity is reached between six and 10 years of age with an average calving interval of two to three years. They mostly inhabit deep, offshore waters of all major oceans. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed, although some fin whales appear to be residential to certain areas. Fin whales eat pelagic crustaceans (mainly euphausiids or krill) and schooling fish such as capelin, herring, and sand lance.

*Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the fin whale.

The pre-exploitation estimate for the fin whale population in the North Pacific was 42,000 to 45,000 (Ohsumi and Wada 1974). In the North Pacific, at least 74,000 whales were killed between 1910 and 1975. In the North Atlantic, at least 55,000 fin whales were killed between 1910 and 1989. Approximately 704,000 whales were killed in the Southern Hemisphere from 1904 to 1975. Of the three to seven stocks in the North Atlantic (approximately 50,000 individuals), one occurs in U.S. waters, where the best estimate of abundance is 1,618 individuals ($N_{min}$=1,234); however, this may be an underrepresentation as the entire range of stock was not surveyed (Palka 2012). There are three stocks in U.S. Pacific waters: Northeast Pacific (minimum 1,368 individuals), Hawaii (approximately 58 individuals [$N_{min}$=27]), and California/Oregon/Washington (approximately 9,029 [$N_{min}$=8,127 individuals]) (Nadeem et al. 2016). The IWC also recognizes the China Sea stock of fin whales, found in the Northwest Pacific, which currently lacks an abundance estimate (Reilly et al. 2013). Abundance data for the Southern Hemisphere stock are limited; however, there were assumed to be somewhat more than 15,000 in 1983 (Thomas et al. 2016).

Current estimates indicate approximately 10,000 fin whales in U.S. Pacific Ocean waters, with an annual growth rate of 4.8 percent in the Northeast Pacific stock and a stable population abundance in the California/Oregon/Washington stock (Nadeem et al. 2016). Overall population growth rates and total abundance estimates for the Hawaii stock, China Sea stock, western north Atlantic stock, and southern hemisphere fin whales are not available at this time.

Archer et al. (2013) recently examined the genetic structure and diversity of fin whales globally. Full sequencing of mitochondrial DNA genome for 154 fin whales sampled in the North Atlantic, North Pacific, and Southern Hemisphere, resulted in 136 haplotypes, none of which were shared among ocean basins suggesting differentiation at least at this geographic scale. However, North Atlantic fin whales appear to be more closely related to the Southern Hemisphere population, as compared to fin whales in the North Pacific, which may indicate a revision of the subspecies delineations is warranted. Generally speaking, haplotype diversity was found to be high both within ocean basins, and across. Such high genetic diversity and lack of differentiation within ocean basins may indicate that despite some population's having small abundance estimates, the species may persist long-term and be somewhat protected from substantial environmental variance and catastrophes.

There are over 100,000 fin whales worldwide, occurring primarily in the North Atlantic, North Pacific, and Southern Hemisphere (Figure 5), where they appear to be reproductively isolated. The availability of prey, sand lance in particular, is thought to have a strong influence on the distribution and movements of fin whales.

*Vocalizations and Hearing*

Fin whales produce a variety of low-frequency sounds in the 10-200 Hz band (Thompson et al. 1992). The most typical signals produced by fin whales are long, patterned sequences of short duration (0.5-2 second) infrasonic pulses in the 18-35 Hz range (Patterson and Hamilton 1964). Estimated source levels for fin whales are 140-200 decibels re 1 µPa at 1 meter (Patterson and Hamilton 1964; Thompson et al. 1992; Clark and Gagnon 2004). Direct studies of fin whale hearing have not been conducted, but it is assumed that fin whales can hear the same frequencies that they produce (low) and are likely most sensitive to this frequency range (Ketten 1997; Richardson et al. 1995a). Fin whales are in the low frequency (LF) cetacean functional hearing group (Southall et al. 2007).

*Status*

The fin whale is endangered as a result of past commercial whaling. Prior to commercial whaling, hundreds of thousands of fin whales existed. Fin whales may be killed under "aboriginal subsistence whaling" in Greenland, under Japan's scientific whaling program, and Iceland's formal objection to the IWC ban on commercial whaling. Japan is withdrawing from IWC in June 2019 and will be resuming commercial whaling. Additional threats include vessel strikes, reduced prey availability due to overfishing or climate change, and noise. The species' overall large population size may provide some resilience to current threats, but trends are largely unknown.

*Status of the Species in the Action Area*

In the North Pacific Ocean, fin whales occur in summer foraging areas in the Chukchi Sea, the Sea of Okhotsk, around the Aleutian Islands, and the Gulf of Alaska (Figure 5); in the eastern Pacific, they occur south to California; in the western Pacific, they occur south to Japan. Fin whales in the eastern Pacific winter from California south; in the western Pacific, they winter from the Sea of Japan, the East China, Yellow, and Philippine Seas (Gambell 1985a).

Several subpopulations of fin whales are thought to exist within the North Atlantic, although some studies have found substantial gene flow between these populations and little genetic divergence suggesting there may only be one functional population (excluding the Mediterranean). The only stock in U.S. waters, the Western North Atlantic Stock, is estimated to comprise 1,618 individuals ($N_{min}$=1,234), although this is likely an underestimate (Hayes et al. 2017a). Like many other baleen whales, fin whales exhibit strong site fidelity and whales of the Western North Atlantic stock are no exception. Waters off New England represent an important feeding area for this stock and calving is thought to occur to the south, along the U.S. mid-Atlantic, although the exact location of breeding remains unknown.

Fin whales in the North Pacific Ocean occur in summer foraging areas in the Chukchi Sea, Bering Sea, the Sea of Okhotsk, around the Aleutian Islands, and in the Gulf of Alaska (Muto et al. 2017b). Peak fin whale call detection in the Bering Sea occurs from September to November and February to March (Stafford et al. 2010), which could be an indication of increased abundance or simply increased calling during these months (NMFS 2018d). Fin whale calls have been recorded year-round in the Gulf of Alaska, but are most prevalent from August-February (Moore et al. 1998; Moore et al. 2006). The abundance of fin whales in Alaska waters appears to be increasing since around 2002 (Friday et al. 2013), and the annual rate of increase of fin whales in coastal waters south of the Alaska Peninsula was estimated to be 4.8 percent between 1987 and 2003 (Zerbini et al. 2006). In the Southern Hemisphere, fin whales range from near 40°S (Brazil, Madagascar, Western Australia, New Zealand, Colombia, Peru, and Chile) during the austral winter southward to Antarctica in the austral summer (Rice 1998). Fin whales appear to be present in Antarctic waters only from February to July and were not detected in the Ross Sea during year-round acoustic surveys in 2008 (Sirovic et al. 2009). Current population estimates are a fraction of former abundance because the population in the Southern Hemisphere was one of the most heavily exploited by commercial whaling. Approximately 200 fin whales have been observed in the Ross Sea (Pinkerton et al. 2010).

*Critical Habitat*

No critical habitat has been designated for the fin whale.

*Recovery Goals*

See the 2010 Final Recovery Plan for the fin whale for complete down listing/delisting criteria for both of the following recovery goals.

1. Achieve sufficient and viable population in all ocean basins.
2. Ensure significant threats are addressed.

### 6.2.2 Bowhead Whale

The bowhead whale is a circumpolar baleen whale found throughout high latitudes in the Northern Hemisphere (Figure 6).

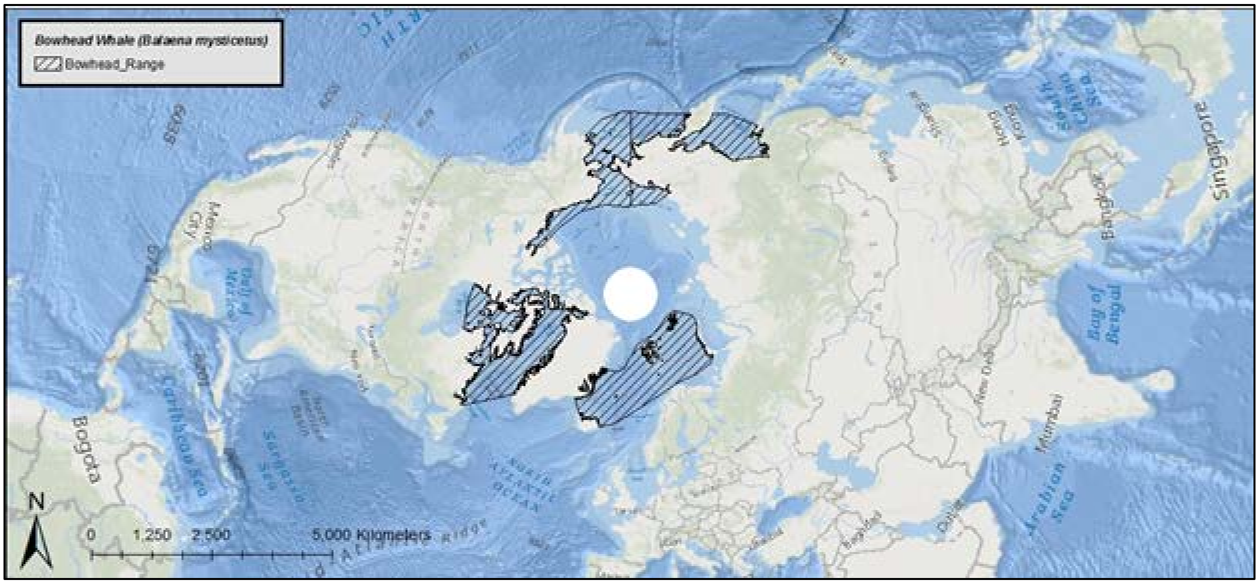


**Figure 6. Map identifying the range of endangered bowhead whales**

Bowheads are baleen whales distinguishable from other whales by a dark body with a distinctive white chin, no dorsal fin, and a bow-shaped skull that takes up about 35 percent of their total body length. The bowhead whale was originally listed as endangered on December 2, 1970.

Information available from the recent stock assessment report (Muto et al. 2017b) and the scientific literature was used to summarize the life history, population dynamics, and status of the species as follows.

*Life History*

The average lifespan of bowhead whales is unknown; however, some evidence suggests that they can live for over one hundred years. They have a gestation period of 13 to 14 months and it is unknown how long calves nurse. Sexual maturity is reached around twenty years of age with an average calving interval of three to four years. They spend the winter associated with the southern limit of the pack ice and move north as the sea ice breaks up and recedes during spring. Bowhead whales use their large skulls to break through thick ice and feed on zooplankton (crustaceans like copepods, euphausiids, and mysids), other invertebrates, and fish.

*Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the bowhead whale.

The global, pre-exploitation estimate for bowhead whales is 30,000 to 50,000 animals. There are currently four or five recognized stocks of bowhead whales, the Western Arctic (or Bering-Chukchi-Beaufort) stock, the Okhotsk Sea stock, the Davis Strait and Hudson Bay stock (sometimes considered separate stocks), and the Spitsbergen stock (Rugh and Shelden 2009). The only stock thought to be found within United States waters is the Western Arctic stock. The

2011 ice-based abundance estimate puts this stock, the largest remnant stock, at over 16,892 ($N_{min}$=16,091) individuals with an annual growth rate of 3.7 percent (Givens et al. 2013). Prior to commercial whaling, there may have been 10,000 to 23,000 whales in this stock (Rugh and Shelden 2009). The Western Arctic stock is found in waters around Alaska, the Okhotsk Sea stock in eastern Russia waters, the Davis Strait and Hudson Bay stock in northeastern waters near Canada, and the Spitsbergen stock in the northeastern Atlantic Ocean (Rugh and Shelden 2009) (Figure 6).

Genetic studies conducted on the Western Arctic stock of bowhead whales revealed 68 different haplotypes defined by 44 variable sites (Leduc et al. 2008) making it the most diverse stock of bowhead whales. These results are consistent with a single stock with genetic heterogeneity related to age cohorts and indicate no historic genetic bottlenecks (Rugh et al. 2003).

*Vocalization and Hearing*

Bowhead whales produce songs of an average source level of 185±2 dB re: 1 µPa at 1 m rms centered at a frequency of 444±48 Hz (Tervo et al. 2012). Given background noise, this allows bowhead whales an active space of 40 to 130 kilometers (21.6 to 70.2 nm; Tervo et al. 2012). We are aware of no information directly on the hearing abilities of bowhead whales, but as with all marine mammals, we presume they hear best in frequency ranges at which they produce sounds (444±48 Hz).

*Status*

The bowhead whale is endangered because of past commercial whaling. Prior to commercial whaling, at least tens of thousands of bowhead whales existed. Global abundance declined to 3,000 by the 1920's. Bowhead whales may be killed under "aboriginal subsistence whaling" provisions of the IWC. Additional threats include ship strikes, fisheries interactions (including entanglement), contaminants, and noise. The species' large population size and increasing trends indicate that it is resilient to current threats.

*Status of the Species in the Action Area*

Bowhead whales are closely associated with sea ice much of the year (Moore and Reeves 1993). The bowhead spring migration from the Bering Sea north to the Chukchi Sea follows polynyas in the sea ice along the coast of Alaska, generally in the zone between the shorefast ice and mobile pack ice. During the summer, most of the Western Arctic bowhead whales are in the southern Beaufort Sea (Muto et al. 2017b). During the fall migration south into the Bering Sea, bowheads appear to select shallow-shelf waters in low to moderate sea ice conditions, and slope waters in heavy ice conditions (Moore et al. 2000). In the Bering Sea wintering grounds bowheads often use areas with 100 percent sea ice cover, even when polynyas are available (Citta et al. 2015; Muto et al. 2017b).

Bowhead whales have also been observed feeding during the summer in the northeastern Chukchi Sea (Clarke and Ferguson 2010). It is likely there is considerable inter-annual variability in the locations where feeding occurs during the summer and fall in the Alaska Beaufort Sea, in the length of time individuals spend feeding, and in the number of individuals feeding in various areas in the Beaufort Sea.

*Critical Habitat*

No critical habitat has been designated for the bowhead whale.

*Recovery Goals*

There is currently no recovery plan available for the bowhead whale.

### 6.2.3 Humpback Whale

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 7).

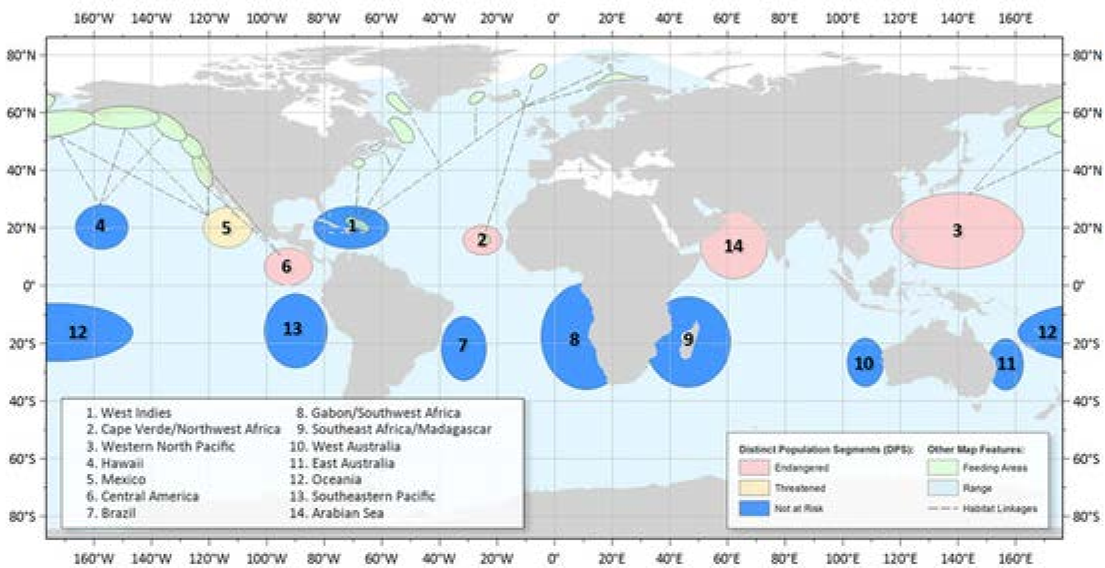


**Figure 7. Map identifying 14 distinct population segments with one threatened and four endangered based on primary breeding locations of the humpback whale, its range, and feeding areas (Bettridge et al. 2015)**

Humpbacks are distinguishable from other whales by long pectoral fins and are typically dark gray with some areas of white. The humpback whale was originally listed as endangered on December 2, 1970 (35 FR 18319). Since then, NMFS has designated fourteen DPSs with four identified as endangered (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea) and one as threatened (Mexico; 81 FR 62259).

Information available from the recovery plan (NMFS 1991), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016), the status review (Bettridge et al. 2015), and the final listing (81 FR 62259) were used to summarize the life history, population dynamics, and status of the species as follows.

*Life History*

Humpbacks can live, on average, fifty years. They have a gestation period of eleven to twelve months, and calves nurse for one year. Sexual maturity is reached between five to eleven years of age with an average calving interval of two to three years. Humpbacks mostly inhabit coastal and continental shelf waters. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed. Humpbacks exhibit a wide range of foraging behaviors and feed on a range of prey types, including: small schooling fishes, euphausiids, and other large zooplankton (Bettridge et al. 2015).

*Population Dynamics*

The following is a discussion of the species' population and its variance over time.

<u>Mexico DPS</u>

This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Mexico humpback whale DPS.

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). The current abundance of the Mexico humpback whale DPS is approximately 3,264 (81 FR 62259).

A population growth rate is currently unavailable for the Mexico humpback whale DPS.

For humpback whales, distinct population segments that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Distinct population segments that have a total population five hundred individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Populations at low densities (less than one hundred) are more likely to suffer from the 'Allee' effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density. The Mexico DPS is estimated to have more than 2,000 individuals and thus, should have enough genetic diversity for long-term persistence and protection from substantial environmental variance and catastrophes (81 FR 62259, Bettridge et al. 2015).

The Mexico DPS consists of humpback whales that breed along the Pacific coast of mainland Mexico and the Revillagigedos Islands, and transit through the Baja California Peninsula coast. The DPS feeds across a broad geographic range from California to the Aleutian Islands, with concentrations in California-Oregon, northern Washington – southern British Columbia, northern and western Gulf of Alaska, and Bering Sea feeding grounds (Figure 7) (81 FR 62259).

<u>Western North Pacific DPS</u>

This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Western North Pacific humpback whale DPS.

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). The current abundance of the Western North Pacific DPS is approximately 1,059 (81 FR 62259).

A population growth rate is currently unavailable for the Western North Pacific humpback whale DPS.

The Western North Pacific DPS has less than 2,000 individuals total, and is made up of two subpopulations, Okinawa/Philippines and the Second West Pacific. Thus, while its genetic diversity may be protected from moderate environmental variance, it could be subject to extinction due to genetic risks due to low abundance (81 FR 62259, Bettridge et al. 2015).

The Western North Pacific DPS consists of humpback whales breeding/wintering in the area of Okinawa and the Philippines, another unidentified breeding area (inferred from sightings of whales in the Aleutian Islands area feeding grounds), and those transiting from the Ogasawara area. These whales migrate to feeding grounds in the northern Pacific, primarily off the Russian coast (Figure 7; 81 FR 62259).

*Vocalization and Hearing*

Humpback whale vocalization is much better understood than its hearing. Different sounds are produced that correspond to different functions: feeding, breeding, and other social calls (Dunlop et al. 2008). Males sing complex sounds while in low-latitude breeding areas in a frequency range of 20 Hz to 4 kHz with estimated source levels from 144 to 174 dB (Au et al. 2006; Richardson et al. 1995b; Au and Green 2000; Frazer and Mercado Iii 2000; Winn et al. 1970). Males also produce sounds associated with aggression, which are generally characterized by frequencies between 50 Hz to 10 kHz with most energy below 3 kHz (Tyack 1983; Silber 1986). Such sounds can be heard up to 9 kilometers (4.9 nm) away (Tyack 1983). Other social sounds from 50 Hz to 10 kHz (most energy below 3 kHz) are also produced in breeding areas (Richardson et al. 1995b; Tyack 1983). While in northern feeding areas, both sexes vocalize in grunts (25 Hz to 1.9 kHz), pulses (25 to 89 Hz), and songs (ranging from 30 Hz to 8 kHz but dominant frequencies of 120 Hz to 4 kHz), which can be very loud (175 to 192 decibels re: 1 μPa @ 1 m rms) (Payne 1985; Richardson et al. 1995b; Thompson et al. 1986; Au et al. 2000; Erbe 2002a). However, humpback whales tend to be less vocal in northern feeding areas than in southern breeding areas (Richardson et al. 1995b). NMFS classified humpback whales in the low-frequency cetacean (i.e., baleen whale) functional hearing group. As a group, it is estimated that baleen whales can hear frequencies between 0.007 and 30 Hz (NOAA 2013). Houser et al. (2001) produced a mathematical model of humpback whale hearing sensitivity based on the anatomy of the humpback whale ear. Based on the model, they concluded that humpback whales would be sensitive to sound in frequencies ranging from 0.7 to 10 kHz, with a maximum sensitivity between 2 to 6 kHz.

In terms of functional hearing capability, humpback whales belong to low frequency cetaceans which have a hearing range of 7 Hz to 22 kHz (Southall et al. 2007). Humpback whale audiograms using a mathematical model based on the internal structure of the ear estimate sensitivity is from 700 Hz to 10 kHz, with maximum relative sensitivity between 2 kHz and 6 kHz (Ketten and Mountain 2014). Research by Au et al. (2001) and Au et al. (2006) off Hawaii indicated the presence of high frequency harmonics in vocalizations up to and beyond 24 kHz. While recognizing this was the upper limit of the recording equipment, it does not demonstrate that humpback whales can actually hear those harmonics, which may simply be correlated harmonics of the frequency fundamental in the humpback whale song. The ability of humpback whales to hear frequencies around 3 kiloHertz may have been demonstrated in a playback study. Maybaum (1990) reported that humpback whales showed a mild response to a handheld sonar marine mammal detection and location device with frequency of 3.3 kHz at 219 dB re: 1 µPa @ 1 m rms or frequency sweep of 3.1 to 3.6 kHz. In addition, the system had some low frequency components (below 1 kHz) which may have been an artifact of the acoustic equipment. This possible artifact may have affected the response of the whales to both the control and sonar playback conditions.

*Status*

Humpback whales were originally listed as endangered as a result of past commercial whaling, and the five DPSs that remain listed (Cape Verde Islands/Northwest Africa, Western North Pacific, Central American, Arabian Sea, and Mexico) have likely not yet recovered from this. Prior to commercial whaling, hundreds of thousands of humpback whales existed. Global abundance declined to the low thousands by 1968, the last year of substantial catches (IUCN 2012). Humpback whales may be killed under “aboriginal subsistence whaling” and “scientific permit whaling” provisions of the IWC. Additional threats include ship strikes, fisheries interactions (including entanglement), energy development, harassment from whale-watching, noise, harmful algal blooms, disease, parasites, and climate change.

<u>Mexico DPS</u>

The species’ large population size and increasing trends indicate that it is resilient to current threats, but the Mexico DPS still faces a risk of becoming endangered within the foreseeable future throughout all or a significant portion of its range.

<u>Western North Pacific DPS</u>

The species’ large population size and increasing trends indicate that it is resilient to current threats, but the Western North Pacific DPS still faces a risk of extinction.

*Status of the Species in the Action Area*

The California/Oregon/Washington stock (coincides with the Central America DPS, Hawaii DPS, and Mexico DPS) showed a long-term increase in abundance from 1990 through 2008, but more recent estimates have shown variable trends in the waters off the U.S. West Coast. The Central North Pacific Ocean stock (coincides with the Hawaii DPS, Mexico DPS, and Western North Pacific DPS) is estimated to increase at an annual rate of 6.6 percent in shelf waters of the northern Gulf of Alaska but current population trends are unavailable for Southeast Alaska.

In Puget Sound (defined as south of Admiralty Inlet), Calambokidis et al. (2003) recorded six humpbacks between 1996 and 2001. However, from January 2003 through July 2012 there were over 60 sightings of humpback whales reported to Orca Network, some of which could be the same individuals (Orca Network 2012). A review of the reported sightings in Puget Sound indicates that humpback whales usually occur as individuals or in pairs (Orca Network 2012). Sightings of humpback whales in Puget Sound vary by location but are infrequent. From the Rich Passage to Agate Passage area in the vicinity of NAVBASE Kitsap Bremerton and Keyport, only one unverified sighting of a humpback whale was reported to Orca Network (2012) from January 2003 through July 2012. In Hood Canal and Dabob Bay (where NAVBASE Kitsap Bangor and the Dabob Bay Range Complex [DBRC] are located, respectively), one humpback whale was observed for several weeks in January and February 2012. Prior to this sighting, there were no confirmed reports of humpback whales entering Hood Canal or Dabob Bay. In the Saratoga Passage area (between NAVSTA Everett and NASWI), one humpback whale was reported in Penn Cove south of Crescent Harbor in July 2008. This is the only humpback report from January 2003 through September 2012 that was considered a likely positive identification (Orca Network 2012). There have been no verified humpback sightings in the Carr Inlet area between January 2003 and July 2012. Two unverified sightings were reported to Orca Network to the north of Carr Inlet, near Point Defiance, Tacoma, over the same time period. The last verified sighting was in June and July of 1988 when two individually identified juvenile humpback whales were observed traveling throughout the waters of southern Puget Sound for several weeks (Calambokidis and Steiger 1990).

Eight stocks of humpback whales occur in waters off Antarctica. Individuals from these stocks winter and breed in separate areas but the degree of gene flow, if any, is uncertain (Carvalho et al. 2011). Genetic relatedness is high between eastern and western Australian breeding populations (Schmitt et al. 2014), while individuals from breeding grounds in Ecuador are somewhat heterogeneous from individuals in other breeding areas, but appear to maintain a genetic linkage (Felix et al. 2009). Humpbacks from these stocks are not part of an ESA-listed DPS.

*Critical Habitat*

NMFS published a proposed rule to designated critical habitat for the Western North Pacific Central America, and Mexico DPSs of humpback whales on October 9, 2019 (84 FR 54354). Proposed critical habitat includes specific marine areas located off the coasts of California, Oregon, Washington, and Alaska. Critical habitat boundaries for the Mexico DPS includes marine waters within designated areas of Alaska, Washington, Oregon, and California (Figure 8). Critical habitat boundaries for the Western North Pacific DPS includes marine waters within designated areas in Alaska (Figure 9). Critical habitat boundaries for the Central America DPS includes marine waters off the coasts of Oregon and California (Figure 10). The essential feature of critical habitat for humpback whales is prey species, primarily euphasusiids, and small pelagic schooling fish of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth. Critical habitat does not include aras owned or controlled by the Department of Defense, or designated for its use, where these areas overlap with the boundaries of proposed critical habitat for the Mexico and Westner North Pacific DPSs of humpback whales, including all areas subject to the Naval Base Ventura County, Point Mugu, California, and the Naval Outlying Field, San Nicolas Island, California approved Integrated Natural Resource Management Plans; and the Quinault Range Site (QRS) with an additional 10-km buffer around the QRS and the Southeast Alaska Acoustic Measurement Facility.

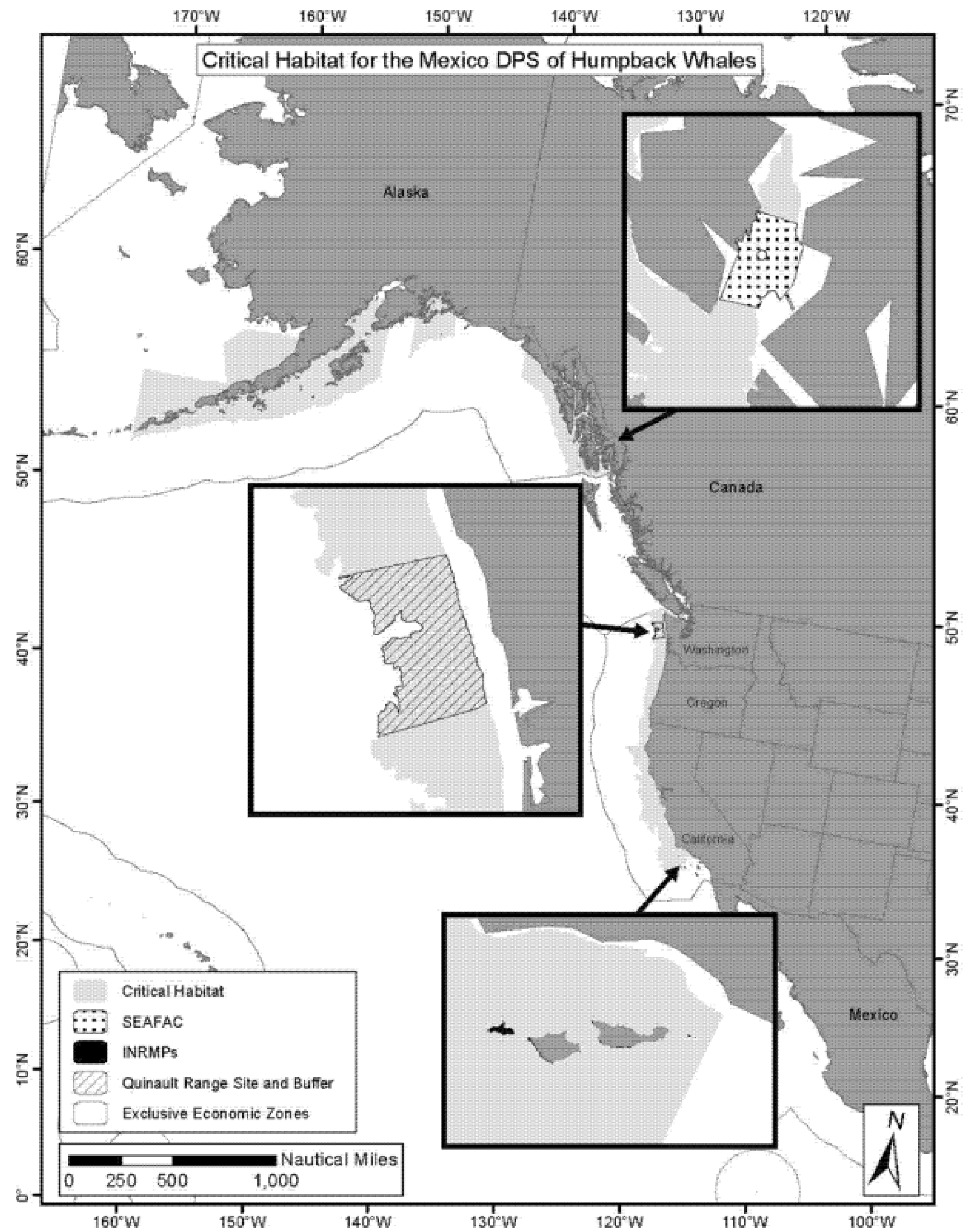


**Figure 8. Overview map of the proposed critical habitat for the Mexico DPS of humpback whales**

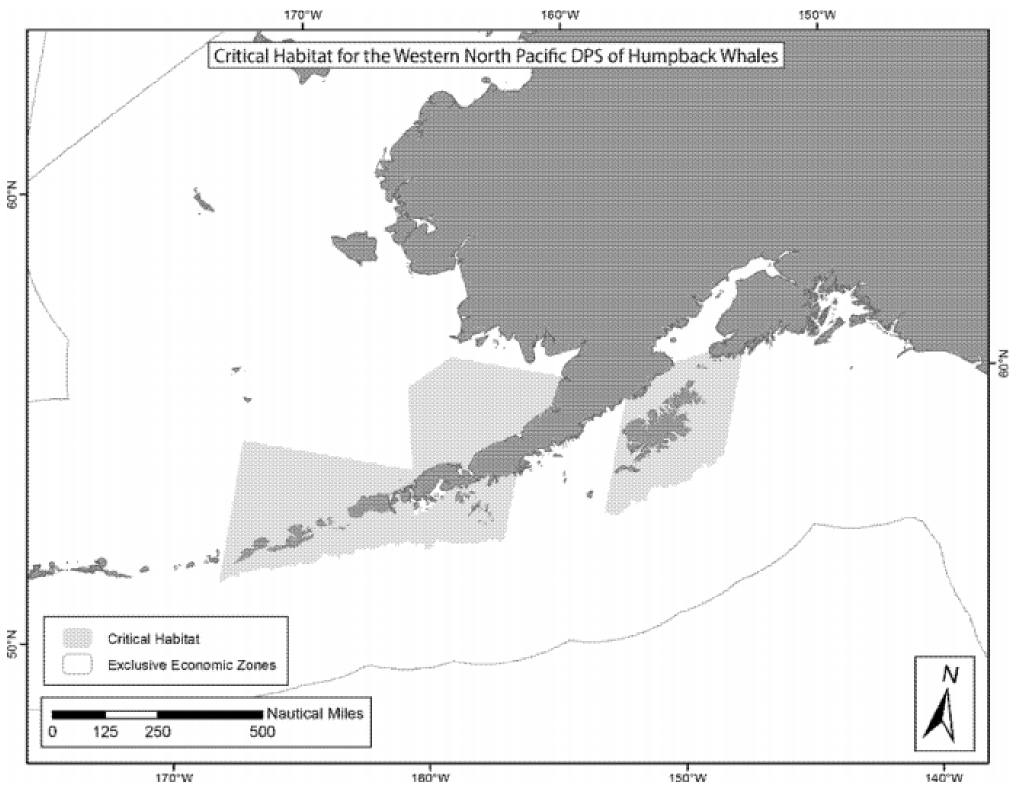


**Figure 9. Overview map of proposed critical habitat for the Western North Pacific DPS of humpback whales**

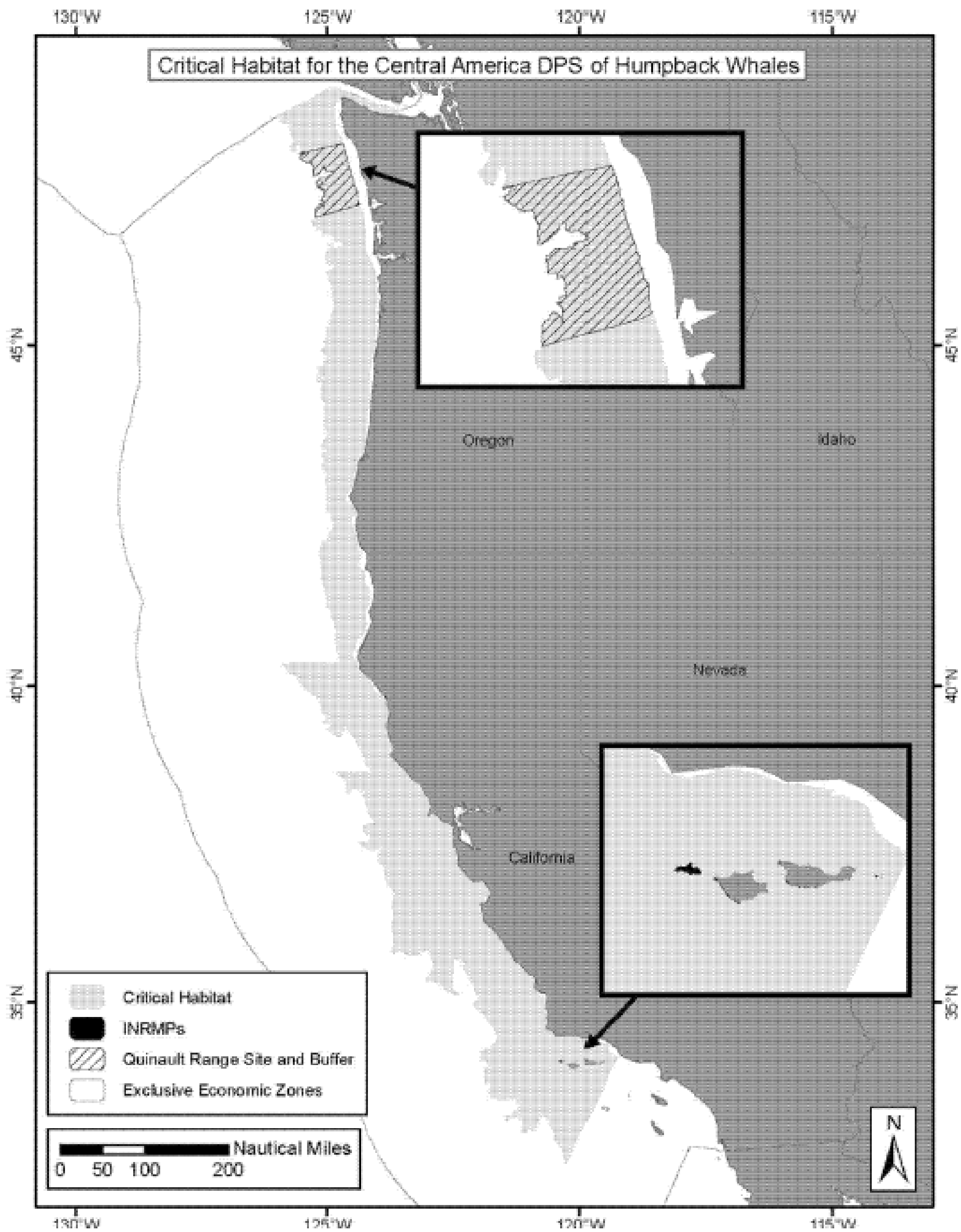


**Figure 10. Overview map of proposed critical habitat for the Central America DPS of humpback whales**

*Recovery Goals*

See the 1991 Final Recovery Plan for the Humpback Whale for complete down listing/delisting criteria for each of the four following recovery goals:

1. Maintain and enhance habitats used by humpback whales currently or historically.
2. Identify and reduce direct human-related injury and mortality.

3. Measure and monitor key population parameters.
4. Improve administration and coordination of recovery program for humpback whales.

### 6.2.4 Ringed Seal - Arctic Subspecies

Ringed seals have widespread, circumpolar distribution, and are found throughout the Arctic Ocean, as well as in the Sea of Okhotsk, Baltic Sea, Lake Ladoga, nd Lake Saimaa (Figure 11). There are five subspecies of ringed seals recognized: Ladoga (*P. h. ladogensis*), Saimaa (*P. h.saimensis*), Okhotsk (*P. h. ochotensis*), Baltic (*P. h. botnica*), and Arctic (*P. h. hispida*).

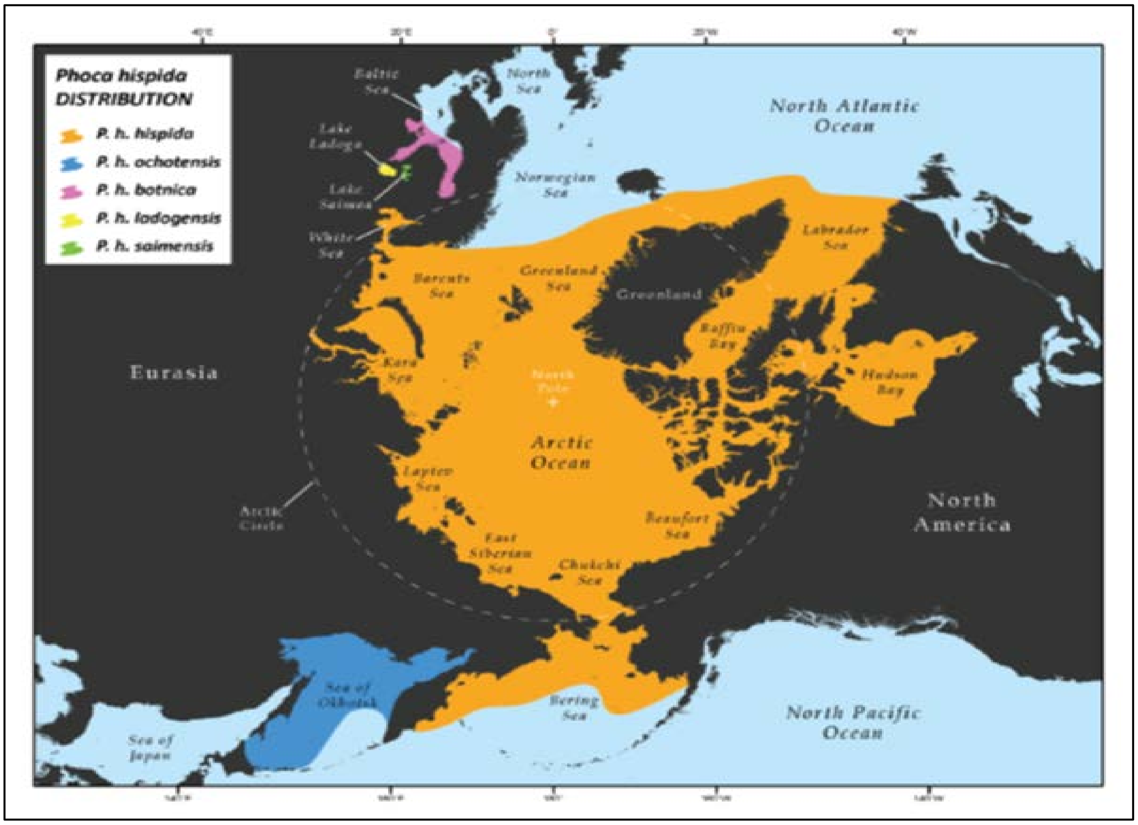


**Figure 11. Map identifying the range of the five subspecies of ringed seal (from Kelly et al. 2010)**

Ringed seals have a dark coat with silver rings. Adults can be up to five feet (1.5 meters) and weigh between 110 and 150 pounds (50 and 70 kilograms). Saimaa ringed seals can weigh up to 240 pounds (110 kilograms). On July 28, 1993, NMFS issues a final determination to list the Saimaa subspecies as endangered. On December 28, 2012, NMFS issued a final determination to list the Arctic, Okhotsk, and Baltic subspecies as threatened and the Ladoga subspecies as endangered under the ESA.

We used information available in the final listing (77 FR 76706) (58 FR 40538), recent stock assessment reports, the status review (Kelly et al. 2010), and available literature to summarize the status of the ringed seal, as follows.

*Life History*

Ringed seals are uniquely adapted to living on the ice. They use stout claws to maintain breathing holes in heavy ice, and excavate lairs in the snow cover above these holes to provide warmth and protection from predators while they rest, pup, and molt. The timing of breeding, whelping, and molting varies spatially and is dependent on the availability of sea ice, with populations at lower latitudes performing these activities earlier in the year. Females give birth in late winter to early spring to a single pup annually; they nurse for five to nine weeks. During this time, pups spend an equal amount of time in the water and in the lair. Females attain sexual maturity at four to eight years of age, males at five to seven years. The average lifespan of a ringed seal is fifteen to twenty-eight years. They are trophic generalists, but prefer small schooling prey that form dense aggregations (Kelly et al. 2010).

*Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the ringed seal.

*Abundance*

No reliable population estimates for the entire Arctic ringed seal population exist due to the species' widespread distribution across political boundaries. In the status review, the population was estimated at approximately two million individuals; however, NMFS considers this a crude estimate, as it relies on outdated data collected in a variety of ways and does not include all areas of its range. In the status review, the population of ringed seals in Alaskan waters of the Chukchi and Beaufort Seas was estimated to be at least 300,000 individuals. This is most likely an underestimate of the true abundance because surveys in the Beaufort Sea were limited to within forty kilometers of the shore (Kelly et al. 2010).

Currently, the population for Saimaa ringed seals is estimated at 320 individuals, calculated by the Metsähallitus Parks and Wildlife in Finland by conducting a snow lair census (Koivuniemi et al. 2016).

There are an estimated 5,068 Ladoga ringed seals (CI 4,026 to 7,086; Trukhanova 2013).

In total, there are approximately between 7,240 and 7,340 individuals in the Baltic ringed seal population, combined across three known sub-populations. There are between 200 and 300 Baltic ringed seals in the Gulf of Finland (Loseva and Sagitov 2013). There are about 1,000 ringed seals in the Gulf of Riga (in western Estonia; Jussi et al. 2013). In 2000, there were 6,040 Baltic ringed seals in Bothnian Bay, Sweden (Sundqvist et al. 2012).

Conservative estimates for the Okhotsk ringed seal place the population abundance at 676,000

(Kelly et al. 2010).

*Population trend*

Due to insufficient data, population trends for the Arctic subspecies cannot be calculated. It is unknown if the population is stable or fluctuating.

The Saimaa ringed seal population has increased since the late twentieth century, with annual variation in population growth of ± 20 seals (Sipila et al. 2013). This apparent population growth is regarded as unstable, however, as changing ice conditions from year to year can influence breeding success.

There is limited population trend information for the Ladoga ringed seal. There is evidence that the Ladoga ringed seal population is showing a positive trend; the 2012 estimate of 5,068 individuals is more than 2.4 times the 2001 estimate (Trukhanova 2013).

There is no population trend available for the Baltic ringed seal as a whole. The sub-population in the Gulf of Finland has experienced a steep decline, from about 4,000 individuals in the 1980s and then increased from less than 100 to 237 in 2013 (Trukhanova 2013). The number of Baltic ringed seals hauled out in Bothnian Bay increased from 1988 to 2000, from 2,000 to 6,040, a population increase of 4.6 percent (Sundqvist et al. 2012). Since ringed seals are so dependent on changing ice conditions for reproductive success, there is uncertainty as to how these trends will continue in the future.

There is no reliable population trend information for the Okhotsk ringed seal.

*Genetics*

The genetic population structure of the Arctic ringed seal is poorly understood. It is likely that population structuring exists in the species, but the extent to which it occurs is unknown.

The Saimaa ringed seal population is characterized as having extremely low genetic diversity (Valtonen et al. 2015). The population exhibits fewer distinct haplotypes than other ringed seal subspecies populations in the region. The Saimaa population has eight distinct haplotypes, while the Ladoga has 13, and the Baltic subspecies has 16 distinct haplotypes (Valtonen et al. 2012). There is clear spatial structuring in the Saimaa population, likely owing to low population density and high fidelity for breeding sites (Valtonen et al. 2012).

There is little genetic information available for the Ladoga ringed seal population. Mitochondrial DNA variability in Ladoga ringed seals is substantially higher than in the nearby Saimaa ringed seal population. The Ladoga population displays 13 distinct haplotypes, compared to eight in Saimaa ringed seals. The nucleotide diversity for the Ladoga population (0.015 ± 0.017) is reduced compared to the nucleotide diversity in the Baltic ringed seal population (0.047 ± 0.038; Valtonen et al. 2012).

The genetic structure of Baltic ringed seals is not well understood. It is possible that population structuring is taking place between the three sub-populations of Baltic ringed seals, due to the species' high fidelity to breeding sites. The Baltic ringed seal population exhibits 16 distinct haplotypes (Valtonen et al. 2012).

There is no available information on the genetic diversity of Okhotsk ringed seals.

*Spatial distribution*

Arctic ringed seals are widely distributed throughout the Arctic Ocean, in waters of Russia, Canada, Greenland, Finland and the United States (Figure 11). In U.S. waters, Arctic ringed seals are found around Alaska in the Bering, Chukchi, and Beaufort Seas. Most seals move seasonally, following the extent of the sea ice.

Saimaa ringed seals are one of two freshwater, landlocked ringed seal populations, and are found in Lake Saimaa, Finland (Figure 11). Most seals move seasonally, following the extent of the ice. Saimaa ringed seal pups are born from February to March in subnivean snow lairs in snow drifts along shorelines of islands, and molt in April during the nursing period (Kunnasranta et al. 2001).

Ladoga ringed seals are one of two freshwater, landlocked ringed seal populations, and are found in Lake Ladoga, Russia (Figure 11). Most seals move seasonally, following the extent of the ice. In spring, seal density is highest in relatively shallow areas less than 50 meters deep (Trukhanova 2013).

Baltic ringed seals are found in the Baltic Sea, bordering Sweden, Finland, Russia, Estonia and Latvia (Figure 11). There are three major sub-populations of Baltic ringed seals, in Bothnian Bay, Sweden, the Gulf of Finland, and the Gulf of Riga, Estonia. Most seals move seasonally, following the extent of the sea ice.

Okhotsk ringed seals occupy the Sea of Okhotsk bordering Russia and Japan (Figure 11). Most seals move seasonally, following the extent of the sea ice.

*Vocalization and Hearing*

Ringed seals vocalize underwater in association with territorial and mating behaviors. Underwater audiograms for phocids suggest that they have very little hearing sensitivity below 1 kHz, though they can hear underwater sounds at frequencies up to 60 kHz and make calls between 90 Hz and 16 kHz (Richardson et al. 1995b). A more recent review suggests that the auditory bandwidth for pinnipeds in water should be considered to be 75 Hz to 75 kHz (Southall et al. 2007). Anthropogenic noise has the potential to mask biologically important sounds and even cause injury to ringed seals (Kelly et al. 2010). Noise exposure may affect the vestibular and neurosensory systems of ringed seals. In pinnipeds, there is direct coupling through the vestibule of the vestibular and auditory systems; therefore, it is possible that noise-induced effects may impact vestibular function as has been shown in land mammals and humans (Southall et al. 2007). Noise-induced effects on vestibular function may be even more pronounced in ringed seals than in land mammals considering a single vibrissa on a ringed seal contains ten times the number of nerve fibers typically found in one vibrissa of a land mammal

(Hyvärinen 1989). Arctic subspecies of ringed seals are in the phocid pinniped functional hearing group (Southall et al. 2007).

*Status*

The Arctic ringed seal is threatened due to climate change, especially from the expected loss of sea ice and snow cover in the foreseeable future. Ringed seals are an important species for Alaska subsistence hunters. There are many subsistence communities in Alaska that are not surveyed, and the current statewide level of subsistence harvest is not known. The minimum estimate of the average annual harvest of ringed seals from 12 communities from 2009 to 2013 is 1,040 ringed seals (Muto et al. 2017b). Additional threats to the species include fisheries interactions (including entanglement), disturbance from vessels, noise from seismic exploration, and oil spills. In summary, the Arctic ringed seal has an apparently large population, making it resilient to immediate perturbations. However, since it is threatened by climate change in the long-term, the species is likely to become endangered in the future.

The Saimaa ringed seal underwent a dramatic decline in the twentieth century, falling from historic levels of between 4,000 and 6,000 to below two hundred individuals in the mid-1980s, mostly due to overexploitation (Kelly et al. 2010; Kokko et al. 1999). Additional anthropogenic threats include contamination from persistent organic pollutants, incidental by-catch in fisheries, and human disturbance during nursing (Kokko et al. 1999). Because of the low genetic diversity, small population size, and unstable population growth, the Saimaa ringed seal is considered to have an elevated risk of extinction (Nyman et al. 2014). The species faces further threats from climate change and the predicted loss of pack ice. Finland banned harvest of Saimaa seals by decree in 1955, though harvest of these animals continued for subsistence purposes and scientified research and bycatch in fishing gear continues to be a threat. Beginning in 2010, a harvest of up to 30 was permitted in the Bothnian Bay (Harkonen et al. 1998; Kelly et al. 2010). The Saimaa ringed seal is not resilient to future perturbations.

Although there is some evidence the population is exhibiting a positive trend, the Ladoga ringed seal population is still regarded as unstable. Poor ice conditions, fishing activity and risk of interactions, and the expected loss of sea ice and snow cover in the foreseeable future, indicate uncertainty about the resiliency of the Ladoga ringed seal population.

Historically, there were approximately between 50,000 to 450,000 Baltic ringed seals (Kokko et al. 1999), and severely reduced by hunting to about 7,000 individuals present in the population today. The Baltic ringed seal population in the Gulf of Finland appears to be increasing (Trukhanova et al. 2013), and the population in Bothnian Bay has increased from 1988 to 2000 at an annual rate of 4.6 percent (Sundqvist et al. 2012). The species faces threats from fisheries by-catch, climate change, and the predicted loss of sea ice. Harvest of Baltic ringed seals was banned by Baltic Sea countries in 1988 (Kelly et al. 2010).

There are about 676,000 Okhotsk ringed seals. Russia permits subsistence hunting and for commercial purposes, but the overall take is thought to be minimal {Kelly, 2010 #50. The

Okhotsk ringed seal has an apparently large population, making it resilient to immediate perturbations. However, threatened by climate change in the long-term, the species is likely to become endangered in the future.

*Status of the Species in the Action Area*

The Arctic ringed seal subspecies is present in the action area and will be adversely affected by the proposed activities.

Throughout most of its range, the Arctic subspecies does not come ashore and uses sea ice as a substrate for resting, pupping, and molting. August to October is an open water or feeding period, early winter to March or May is a period when seals rest in subsurface caves, and the breeding/molting period begins once ice begins to melt and break up (Kelly et al. 2010; Born et al. 2004). Arctic ringed seals in the Beaufort and Chukchi Seas spend most of their time in the water or in snowy lairs (90 percent August-November, 20 percent December-March) except during the spring molt when they spend an average of 55 percent of their time basking on ice (Smith and Stirling 1975; Kelly et al. 2010). Arctic ringed seals rest in their lairs from April to mid-May, particularly at night (Kelly et al. 2010). Ringed seals spend more time on ice once spring temperatures warm and lairs start becoming exposed, which occurs from approximately March to early June in the Bering and Chukchi Seas (Kelly et al. 2010). Basking while molting reaches a peak in the Arctic during June (Born et al. 2002; Carlens et al. 2006; Kelly et al. 2010; Harwood et al. 2007). Time out of water increases in June (Kelly et al. 2010).

The Arctic ringed seal is the most abundant of the ringed seal subspecies and has a circumpolar distribution. Arctic seals occur as far south as Newfoundland and Baffin Bay and the Bering Sea in the Pacific (King 1983; Mansfield 1967). While accurate population estimates are not available, it is estimated that the total population of ringed seals in the Chukchi and Beaufort Seas is 1 million seals (Kelly et al. 2010). Based on this and information from areas through the range of this subspecies, the population of the Arctic ringed seal is estimated in the millions.

*Critical Habitat*

Critical habitat for Arctic ringed seals was proposed for designation in the Bering, Chukchi, and Beaufort seas in Alaska (79 FR 73010; Section 6.2.5). There is no designated critical habitat for the Saimaa, Ladoga, Baltic, or Okhotsk ringed seal because NMFS cannot designate critical habitat in foreign waters.

*Recovery Goals*

NMFS has not prepared a Recovery Plan for the Saimaa, Ladoga, Baltic, or Okhotsk ringed seal. In general, listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans because NMFS has no jurisdictional authority outside the U.S. (55 FR

24296; June 15, 1990).

NMFS has not prepared a Recovery Plan for the Arctic ringed seal.

### 6.2.5 Proposed Critical Habitat, Arctic Ringed Seal

Critical habitat was proposed for the Arctic ringed seal on December 9, 2014 (79 FR 73010) and includes all contiguous marine waters from the Alaskan coastline to an offshore limit within the EEZ (Figure 12).

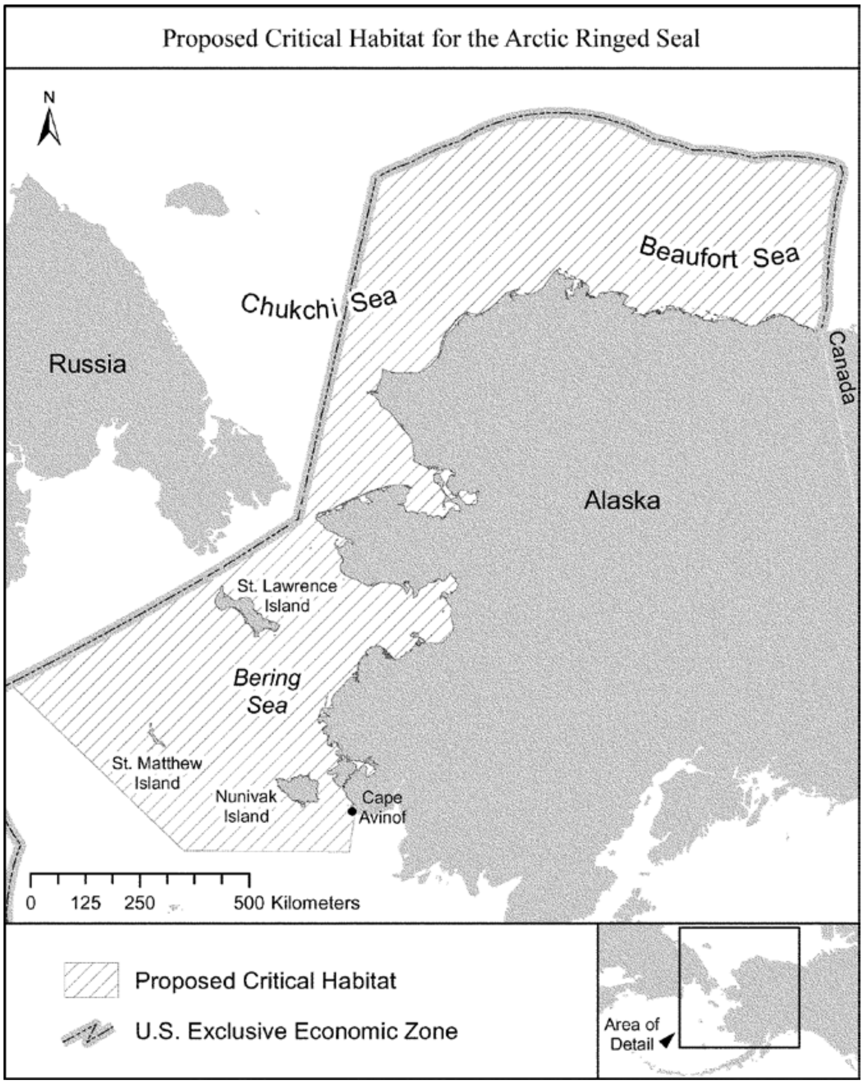


**Figure 12. Map showing the proposed critical habitat for the Arctic subspecies of ringed seal**

Within the geographical area occupied by a listed species, critical habitat consists of specific areas on which are found those physical or biological features essential to the conservation of the species. Physical or biological features essential to the conservation of Arctic ringed seals includes sea ice habitat suitable for the formation of and maintenance of subnivean birth lairs for sheltering pups during whelping and nursing, sea ice habitat suitable as a platform for basking and molting, and primary prey resources to support Arctic ringed seals (79 FR 73010).

Habitat suitable for birth lairs is defined as seasonal land-fast (shore-fast) ice, except for any bottom-fast ice extending seaward from the coast line in waters less than 2 m deep, or dense, stable pack ice, that has undergone deformation and contains snowdrifts at least 54 cm deep. These snowdrifts tend to occur in deformed ice where snow can accumulate. Birth lairs offer pups protection from weather and predators. Arctic ringed seal preferred whelping habitat appears to be land-fast ice, but this ice can freeze to the sea bottom (bottom-fast) where water depth is less than approximately 2 meters, making it unsuitable for birth lairs in these areas. Whelping has also been observed on drifting pack ice in the Barents Sea and Baffin Bay (reviewed in 79 FR 73010).

Habitat suitable for basking and molting is defined as sea ice of 15 percent or more concentration, except for any bottom-fast ice extending seaward from the coast line in waters less than 2 meters deep. This habitat is necessary for Arctic ringed seals to carry out the process of molting, an important biological process that rids the animals of parasites but could be more energetically expensive if it were to occur in the water and may leave the animals more vulnerable to predators if the process were to occur on land. Limited data is available regarding preferred ice concentrations (percentage of ocean surface covered by ice) but Crawford et al. (2012) reported average ice concentrations of 20 percent for sub-adults and 38 percent for adults when hauled out during the June molting period in the Chukchi and Bering Seas (reviewed in 79 FR 73010).

Primary resources for Arctic ringed seals are defined to be Arctic cod, saffron cod, shrimps, and amphipods. These prey items comprise the highest proportions of the Arctic ringed seal diet along the coast of Alaska (reviewed in 79 FR 73010).

For a discussion regarding the possible of effects of climate change on Arctic ringed seals and their critical habitat, see Section 7.1.

### 6.2.6 Bearded Seal - Beringia Distinct Population Segment

Two subspecies of bearded seals are recognized by NMFS: *Erignathus barbatus nauticus* in the Pacific and *Erignathus barbatus barbatus* in the Atlantic (Figure 13). Bearded seals in the Pacific are distributed from 85º N south to Sakhalin Island (45º N), including the Chukchi, Bering, and Okhotsk Seas.

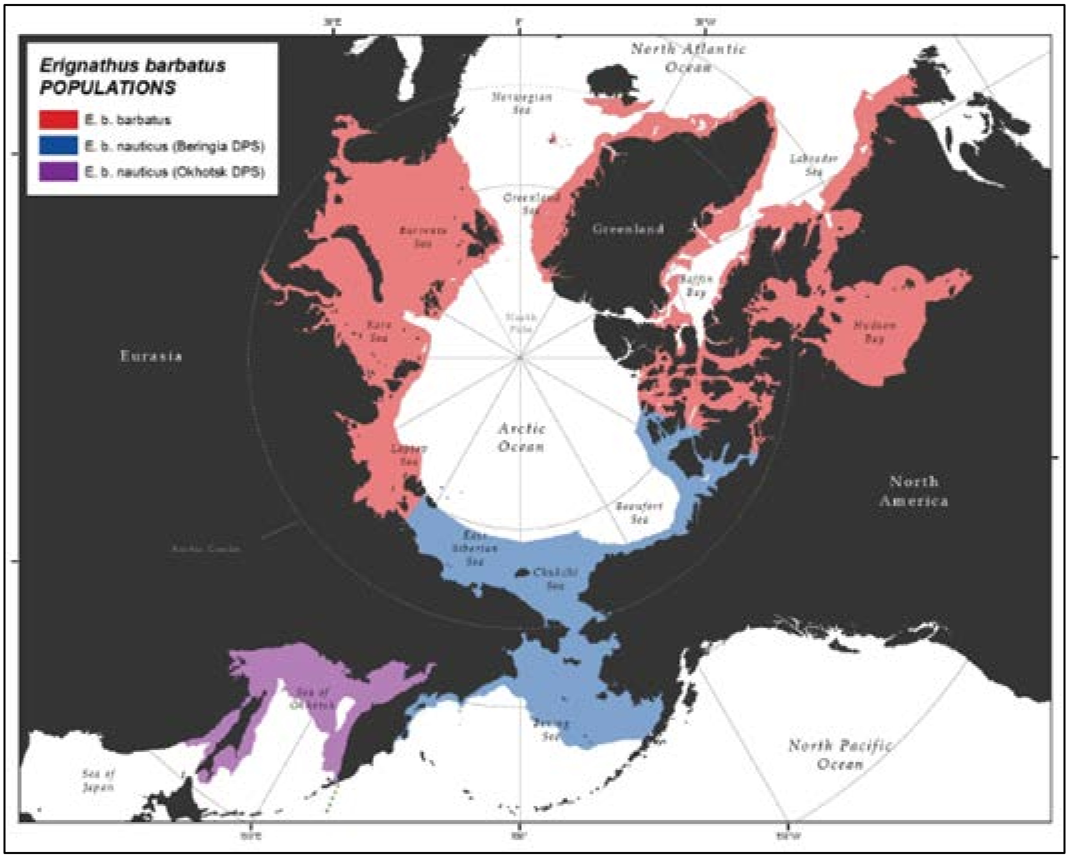


**Figure 13. Map identifying the range of the two subspecies of bearded seal, *Erignathus barbatus barcatus* and *E.b. nauticus*, and the Beringia and Okhotsk DPSs (from Carmeron et al. 2010)**

Bearded seals are distinguished by their small head, small square foreflippers, and thick, long, white whiskers that have resulted in the name "bearded." Pups have lighter markings on the face, resembling a "T". The bearded seal is divided into two subspecies, with the Pacific subspecies (*E. b. nauticus*) further divided into two geographically and ecologically discrete DPSs; the Beringia DPS and the Okhotsk DPS. On December 20, 2012, the NMFS issued a final determination to list the Beringia DPS and Okhotsk DPS as threatened under the ESA (77 FR 76739). The U.S. District Court for the District of Alaska issued a decision that vacated the ESA listing of the Beringia DPS of bearded seals on July 25, 2014 (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB). The NMFS appealed that decision. On October 24, 2016, the Ninth Circuit Court ruled that the listing decision is reasonable and the threatened status of the Beringia DPS bearded seal was upheld.

We used information available in the final listing (77 FR 76739), the status review {Cameron, 2010 #51}, the 2016 stock assessment report (Muto et al. 2017b) and available literature to summarize the status of the bearded seal, as follows.

*Life History*

Generally, bearded seals move north in late spring and summer, staying along the edge of the pack ice in summer, and then move south in the fall. Bearded seals can live up to twenty to twenty-five years old. Female bearded seals become sexually mature at five or six years of age, males at six or seven. Breeding occurs from March to July. Male bearded seals vocalize during the breeding season, with a peak in calling during and after pup rearing. These calls are likely used to attract females and defend their territories to other males (Cameron et al. 2010). Pups are born between mid-March and May, and are usually weaned in fifteen days. Dependent pups spend about fifty percent of their time in the water. Nursing females spend more than ninety percent of their time in water, more than other large phocid seals. Bearded seals forage on a wide variety of benthic invertebrates, demersal fishes and sometimes, schooling fishes.

*Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Beringia DPS of the bearded seal.

The estimated population size of the Beringia bearded seal DPS is 155,000 individuals (75 FR 77496). There is substantial uncertainty around this estimate, however, and population trends for the DPS are unknown (Muto et al. 2017b). An estimate of bearded seals in the western Bering Sea (63,200; 95 percent CI 38,400 to 138,600) from 2003 to 2008 appears to be similar in magnitude to an estimate from 1974 through 1987 (57,000 to 87,000; Cameron et al. 2010).

There has been some study of the population structure of bearded seals, but it has not been possible to determine if Okhotsk DPS bearded seals are genetically distinct from other Pacific bearded seals (*E.b. nauticus*; Cameron et al. 2010; Davis et al. 2008). The DPS determination was made on the basis that the Kamchatka Peninsula behaviorally isolates the breeding population in the Sea of Okhotsk.

Bearded seals are boreoarctic with a circumpolar distribution and are closely associated with sea ice. Most seals move seasonally, following the extent of the sea ice; however some remain near the coasts during the summer and early fall. Bearded seals in the Beringia DPS are found in the continental shelf waters throughout the Eastern Siberian, Chukchi, and Beaufort Seas.

*Vocalization and Hearing*

Pinnipeds have a well-developed vestibular apparatus that likely provides multiple sensory cues similar to those of most land mammals (Southall et al. 2007). Underwater audiograms for phocids suggest that they have very little hearing sensitivity below 1 kHz, though they can hear underwater sounds at frequencies up to 60 kHz and make calls between 90 Hz and 16 kHz (Richardson et al. 1995b). A more recent review suggests that the auditory bandwidth for pinnipeds in water should be considered to be 75 Hz to 75 kHz (Southall et al. 2007). Anthropogenic noise has the potential to mask biologically important sounds for bearded seals, resulting in increased energy expenditure and changes in behavior (Cameron et al. 2010). Noise exposure may affect the vestibular and neurosensory systems of bearded seals. In pinnipeds, there is direct coupling through the vestibule of the vestibular and auditory systems; therefore, it is possible that noise-induced effects may impact vestibular function as has been shown in land mammals and humans (Southall et al. 2007). Bearded seals are in the phocid pinniped functional hearing group (Southall et al. 2007).

*Status*

The Beringia bearded seal DPS has a large, apparently stable population size, which makes it resilient to immediate perturbations. It is, however, threatened by future climate change, specifically the loss of essential sea ice and change in prey availability, and as a result, is likely to become endangered in the future. Bearded seals are an important species for Alaska subsistence hunters. Information from 2009-2013 is available for 12 communities, although more than 50 other communities harvest this species and were not surveyed over this time period or have never been surveyed (Muto et al. 2017b). Based on the harvest data from these 12 communities over this time period, the minimum annual harvest is estimated as 390 animals. Additional threats to the species include disturbance from vessels, sound from seismic exploration, and oil spills.

*Status of the Species in the Action Area*

The Beringia bearded seal DPS is present in the action area and will be affected by the proposed activities.

In the Bering Sea where the Beringia bearded seal DPS is present, early springtime sea ice habitat is used for whelping. Springtime ice is also used during this period for nursing, mating, and some molting. The region that includes the Bering and Chukchi Seas is the largest area of continuous habitat for bearded seals (Cameron et al. 2010). The Bering-Chukchi platform is a shallow, intercontinental shelf where bearded seals can reach the bottom throughout the platform encompassing about half the Bering Sea, spanning the Bering Strait, and covering nearly all of the Chukchi Sea, meaning the area contains favorable foraging habitat (Cameron et al. 2010). During the breeding season, in May-June, bearded seals in the Bering Sea are near the ice front usually northward in heavier ice pack. As the ice retreats in the spring, most adults in the Bering Sea are thought to move north through the Bering Strait to spend summer and early fall at the southern edge of the Chukchi and Beaufort Sea pack is and the margin of multi-year ice (Cameron et al. 2010). Juveniles often remain near the coasts of the Bering and Chukchi Seas for the summer and early fall instead of moving with the ice edge and are found in bays, brackish water estuaries, river mouths, and even traveling up rivers (Cameron et al. 2010).

In the Bering Sea, the highest densities of seals in early spring have been observed between St. Lawrence and St. Matthew Islands (Cameron et al. 2010). Wintering and whelping bearded seals also occupy coastal leads of the Bering and Chukchi Sea, such as in Bristol and Kuskokwim Bays, Norton and Kotzebue Sounds, the Gulfs of Karaginskiy and Anadyr, and near Point Hope (Cameron et al. 2010). The bearded seal population within the Beringia DPS is thought to be greater than that of the Okhotsk DPS. The Biological Review Team that conducted the status review for bearded seals recommends considering the current total Bering Sea bearded seal population to be approximately 125,000 individuals and the population in the U.S. portion of the

Chukchi Sea as approximately 13,600 individuals based on aerial survey data (Cameron et al. 2010). There were no reliable numbers from aerial surveys to enable an estimate of the population in the Beaufort Sea.

*Critical Habitat*

Critical habitat has not been designated for the Beringia DPS bearded seal. NMFS is in the process of drafting a proposed rule designating critical habitat for this species, but a date for publication of a draft rule is not available as of the date of this Opinion.

*Recovery Goals*

A Recovery Plan has not been prepared for the Beringia DPS bearded seal.

# 7 ENVIRONMENTAL BASELINE

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 C.F.R. §402.02; 84 FR 44976 published August 27, 2019).

A number of human activities have contributed to the status of populations of ESA-listed bowhead, fin, and humpback (Western North Pacific and Mexico DPSs) whales, ringed seal Arctic subspecies, and bearded seal Beringia DPS in the action area, particularly in the Arctic operations area. Some human activities are ongoing and appear to continue to affect cetacean and pinniped populations in the action area for this consultation. Some of these activities, most notably commercial whaling, occurred extensively in the past and continue at low levels that no longer appear to significantly affect cetacean populations, although the effects of past reductions in numbers persist today. The following discussion summarizes these impacts, which include climate change; commercial and recreational fisheries; whaling, subsistence hunting, and cultural resources; vessel traffic and tourism; water quality degradation; ocean noise; oil and gas activities; scientific research; and military activities. Predation, a natural phenomenon that also affects these four species, is also discussed below.

## 7.1 Climate Change

There is a large and growing body of literature on past, present, and future impacts of global climate change, exacerbated and accelerated by human activities. Effects of climate change include sea level rise, increased frequency and magnitude of severe weather events, changes in air and water temperatures, changes in the quality and quantity of ice, and changes in precipitation patterns, all of which are likely to impact ESA resources. NOAA's climate information portal provides basic background information on these and other measured or anticipated climate change effects (see https://www.climate.gov).

In order to evaluate the implications of different climate outcomes and associated impacts throughout the 21st century, many factors have to be considered with greenhouse gas emissions and the potential variability in emissions serving as a key variable. Developments in technology, changes in energy generation and land use, global and regional economic circumstances, and population growth must also be considered.

A set of four scenarios was developed by the Intergovernmental Panel on Climate Change (IPCC) to ensure that starting conditions, historical data, and projections are employed consistently across the various branches of climate science. The scenarios are referred to as representative concentration pathways (RCPs), which capture a range of potential greenhouse gas emissions pathways and associated atmospheric concentration levels through 2100 (IPCC 2014). The RCP scenarios drive climate model projections for temperature, precipitation, sea level, and other variables: RCP2.6 is a stringent mitigation scenario; RCP2.5 and RCP6.0 are intermediate scenarios; and RCP8.5 is a scenario with no mitigation or reduction in the use of fossil fuels. IPCC future global climate predictions (2014 and 2018) and national and regional climate predictions included in the 2018 Fourth National Climate Assessment for U.S. states and territories use the RCP scenarios.

The increase of global mean surface temperature change by 2100 is projected to be 0.3 to 1.7°C under RCP2.6, 1.1 to 2.6°C under RCP 4.5, 1.4 to 3.1°C under RCP6.0, and 2.6 to 4.8°C under RCP8.5 with the Arctic region warming more rapidly than the global mean under all scenarios (IPCC 2014). The observed acceleration in carbon emissions over the last 15 to 20 years, even with a lower trend in 2016, has been consistent with higher future scenarios such as RCP8.5 (Hayhoe et al. 2018).

The globally-averaged combined land and ocean surface temperature data, as calculated by a linear trend, show a warming of approximately 1.0°C from 1901 through 2016 (Hayhoe et al. 2018). The IPCC Special Report on the Impacts of Global Warming (2018) noted that human-induced warming reached temperatures between 0.8 and 1.2°C above pre-industrial levels in 2017, likely increasing between 0.1 and 0.3°C per decade. Warming greater than the global average has already been experienced in many regions and seasons, with most land regions experiencing greater warming than over the ocean (Allen et al. 2018). Annual average temperatures have increased by 1.8°C across the contiguous U.S. since the beginning of the 20th century with Alaska warming faster than any other state and twice as fast as the global average since the mid-20th century (Jay et al. 2018). Global warming has led to more frequent heatwaves in most land regions and an increase in the frequency and duration of marine heatwaves (Hoegh-Guldberg et al. 2018). Average global warming up to 1.5°C as compared to pre-industrial levels is expected to lead to regional changes in extreme temperatures, and increases in the frequency and intensity of precipitation and drought (Hoegh-Guldberg et al. 2018).

Several of the most important threats contributing to the extinction risk of ESA-listed species, particularly those with a calcium carbonate skeleton such as corals and mollusks as well as species for which these animals serve as prey or habitat, are related to global climate change. The main concerns regarding impacts of global climate change on coral reefs and other calcium carbonate habitats generally, and on ESA-listed corals and mollusks in particular, are the magnitude and the rapid pace of change in greenhouse gas concentrations (e.g., carbon dioxide and methane) and atmospheric warming since the Industrial Revolution in the mid-19th century. These changes are increasing the warming of the global climate system and altering the carbonate chemistry of the ocean (ocean acidification; (ocean acidification; IPCC 2014). As carbon dioxide concentrations increase in the atmosphere, more carbon dioxide is absorbed by the oceans, causing lower pH and reduced availability of calcium carbonate. Because of the increase in carbon dioxide and other greenhouse gases in the atmosphere since the Industrial Revolution, ocean acidification has already occurred throughout the world's oceans, including in the Caribbean, and is predicted to increase considerably between now and 2100 (IPCC 2014).

The Atlantic Ocean appears to be warming faster than all other ocean basins except perhaps the southern oceans (Cheng et al. 2017). In the western North Atlantic Ocean surface temperatures have been unusually warm in recent years (Blunden and Arndt 2016). A study by Polyakov et al. (2009) suggests that the North Atlantic Ocean overall has been experiencing a general warming trend over the last 80 years of 0.031±0.0006 degrees Celsius per decade in the upper 2,000 meters (6,561.7 feet) of the ocean. Additional consequences of climate change include increased ocean stratification, decreased sea-ice extent, altered patterns of ocean circulation, and decreased ocean oxygen levels (Doney et al. 2012). Since the early 1980s, the annual minimum sea ice extent (observed in September each year) in the Arctic Ocean has decreased at a rate of 11 to 16 percent per decade (Jay et al. 2018). Further, ocean acidity has increased by 26 percent since the beginning of the industrial era (IPCC 2014) and this rise has been linked to climate change. Climate change is also expected to increase the frequency of extreme weather and climate events including, but not limited to, cyclones, tropical storms, heat waves, and droughts (IPCC 2014).

Climate change has the potential to impact species abundance, geographic distribution, migration patterns, and susceptibility to disease and contaminants, as well as the timing of seasonal activities and community composition and structure (MacLeod et al. 2005; Robinson et al. 2005; Learmonth et al. 2006; Kintisch 2006; McMahon and Hays 2006; Evans and Bjørge 2013; IPCC 2014). Though predicting the precise consequences of climate change on highly mobile marine species is difficult (Simmonds and Isaac 2007), recent research has indicated a range of consequences already occurring. For example, in sea turtles, sex is determined by the ambient sand temperature (during the middle third of incubation) with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25 to 35°C (Ackerman 1997). Increases in global temperature could skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007). These impacts will be exacerbated by sea level rise. The loss of habitat because of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Changes in the marine ecosystem caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen levels, nutrient distribution) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish), ultimately affecting primary foraging areas of ESA-listed species including marine mammals, sea turtles, and fish. Marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012). Hazen et al. (2012) examined top predator distribution and diversity in the Pacific Ocean in light of rising sea surface temperatures using a database of electronic tags and output from a global climate model. They predicted up to a 35 percent change in core habitat area for some key marine predators in the Pacific Ocean, with some species predicted to experience gains in available core habitat and some predicted to experience losses. Notably, leatherback turtles were predicted to gain core habitat area, whereas loggerhead turtles and blue whales were predicted to experience losses in available core habitat. McMahon and Hays (2006) predicted increased ocean temperatures will expand the distribution of leatherback turtles into more northern latitudes. The authors noted this is already occurring in the Atlantic Ocean. MacLeod (2009) estimated, based upon expected shifts in water temperature, 88 percent of cetaceans will be affected by climate change, with 47 percent predicted to experience unfavorable conditions (e.g., range contraction). Willis-Norton et al. (2015) acknowledged there will be both habitat loss and gain, but overall climate change could result in a 15 percent loss of core pelagic habitat for leatherback turtles in the eastern South Pacific Ocean.

Similarly, climate-related changes in important prey species populations are likely to affect predator populations. For example, blue whales, as predators that specialize in eating krill, are likely to change their distribution in response to changes in the distribution of krill (Payne et al. 1986; Payne et al. 1990; Clapham et al. 1999). Pecl and Jackson (2008) predicted climate change will likely result in squid that hatch out smaller and earlier, undergo faster growth over shorter life-spans, and mature younger at a smaller size. This could have negative consequences for species such as sperm whales, whose diets can be dominated by cephalopods. For ESA-listed species that undergo long migrations, if either prey availability or habitat suitability is disrupted by changing ocean temperature regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott 2009).

In all regions except the Bering Sea, the duration of summer when ice cover is reduced increased by 5-10 weeks and by more than 20 weeks in the Barents Sea between 1979-2013 (Laidre et al. 2015). Warming in the Arctic over the past few decades has been about twice the global mean (IPCC 2013). Even if greenhouse gases are limited immediately, sea ice loss, which has been faster than originally predicted by climate models, will still continue for several decades potentially leading to ice-free summers by 2040 (Laidre et al. 2015; Overland and Wang 2013;

Wang et al. 2016). Changes in sea ice will also affect the food web through changes in the timing and quantity of primary production (spring phytoplankton blooms) that in turn would affect lower trophic levels and benthic invertebrates and subsequently higher trophic levels (Wang et al. 2016).

Climate affects the distribution of ringed seals due to its influence on sea ice. Warm temperatures and reduced snow cover result in pre-weaning lair melting, collapse, and/or abandonment; hypothermia; and high rates of predation as predators have freer movement through ice-free water and over areas that are not snow covered. Harwood et al. (2000) reported reduced growth and survival rates because of an early spring break up of ice. Because the depth and duration of snow cover is projected to decrease through the range of the ringed seal Arctic subspecies this century, increased juvenile mortality is likely (Kelly et al. 2010). Crawford et al. (2012) documented large differences in movement and habitat use between adult and subadult ringed seals during the winter-spring season when seasonal sea ice covers the Bering and Chukchi Seas. Adult seals made localized movements in shorefast or heavy pack ice in the southern Chukchi and northern Bering Seas. Subadults followed the advancing ice southward into the Bering Sea and made larger daily movements. Subadults were also found farther from shore, nearer the southern ice edge, and in deeper waters than adults (Crawford et al. 2012). These differences may not apply to other areas in the Arctic but are important given the potential changes in sea ice due to climate change.

Ringed seals appeared to be least affected by changes in sea ice algae possibly because seals that were sampled had been feeding in the southern Chukchi and Bering Seas, where diets of Arctic cod (on which the seals were feeding) were likely dominated by taxa that were not as directly associated with ice algae (Wang et al. 2016). The most likely impact of ocean acidification on ringed seals will be through affects to lower trophic levels that serve as prey to the species ringed seals consume. Warming water temperatures and decreasing sea ice will also alter the range of prey species consumed by ringed seals. Overall, climate change poses a moderate to high threat to ringed seals (Kelly et al. 2010).

About 70 percent of the bearded seal Beringia DPS currently whelps in the Bering Sea where a longer ice-free period is forecasted in May and June. Bearded seals would likely have to shift their nursing, rearing, and molting areas to the ice covered seas north of the Bering Strait where food resources are poorer or to coastal haul-out sites on shore with increased risks of disturbance, predation, and competition for resources including space. The spring and summer ice edge may retreat to deep waters of the Arctic Ocean basin, which could separate sea ice suitable for maturation of pups and molting from benthic foraging habitat (Cameron et al. 2010).

Wang et al. (2016) found that bearded seals were strongly linked with sea ice algae likely due to their dependence on benthic fauna that efficiently consume and assimilate ice algae. Ocean acidification may impact bearded seals through changes in prey populations, particularly calcifiers or those that feed on calcifiers. Ocean acidification may also impact bearded seals by altering the propagation of sound. Low frequency sounds may propagate more readily in more acidic oceans but this will also increase the potential for masking when man-made sounds are present (Cameron et al. 2010). As vessel traffic increases with the increased melting of sea ice, masking of sounds such as vocalizations by male bearded seals has the potential to affect reproduction of this species in areas where ship traffic and other human uses overlap with bearded seal breeding locations (Cameron et al. 2010). Overall, climate change poses a moderate to high threat to bearded seals (Cameron et al. 2010).

### 7.2 Commercial and Recreational Fisheries

Fisheries constitute an important and widespread use of the ocean resources throughout the action area. Fisheries can adversely affect fish populations, other species, and habitats. Direct effects of fisheries interactions on marine mammals include entanglement and entrapment, which can lead to fitness consequences or mortality as a result of injury or drowning. Effects include reduced prey availability, including overfishing of targeted species, and destruction of habitat. Use of mobile fishing gear, such as bottom trawls, disturbs the seafloor and reduces structural complexity. Impacts of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (i.e., lost fishing gear continuing to ensnare fish and other marine animals), and generation of marine debris. Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats and have the potential to entangle or be ingested by marine mammals.

Fisheries can have a profound influence on fish populations. In a study of retrospective data, Jackson, Jackson et al. (2001) concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance of coastal ecosystems, including pollution and anthropogenic climactic change. Marine mammals are known to feed on several species of fish that are harvested by humans (Waring et al. 2008). Thus, competition with humans for prey is a potential concern. Reductions in fish populations, whether natural or human-caused, may affect the survival and recovery of several populations.

Globally, 6.4 million tons of fishing gear is lost in the oceans every year (Wilcox et al. 2015). Entrapment and entanglement in fishing gear is a frequently documented source of human-caused mortality in cetaceans (see Dietrich et al. 2007). In an extensive analysis of global risks to marine mammals, incidental catch was identified as the most common threat category (Avila et al. 2018). Materials entangled tightly around a body part may cut into tissues, enable infection, and severely compromise an individual’s health (Derraik 2002). Entanglements also make animals more vulnerable to additional threats (e.g., predation and vessel strikes) by restricting agility and swimming speed. The majority of cetaceans that die from entanglement in fishing gear likely sink at sea rather than strand ashore, making it difficult to accurately determine the extent of such mortalities. In excess of 97 percent of entanglement is caused by derelict fishing gear (Baulch and Perry 2014).

Cetaceans are also known to ingest fishing gear, likely mistaking it for prey, which can lead to fitness consequences and mortality. Necropsies of stranded whales have found that ingestion of net pieces, ropes, and other fishing debris has resulted in gastric impaction and ultimately death

(Jacobsen et al. 2010). As with vessel strikes, entanglement or entrapment in fishing gear likely has the greatest impact on populations of ESA-listed marine mammal species with the lowest abundance (e.g., Kraus et al. 2016). In 2015, we received a substantial increase in the number of confirmed reports of whales entangled in fishing gear (49 confirmed reports), and this continued in 2016 with 48 confirmed whale entanglements along the U.S. west coast. The number of large whale entanglement reports declined in 2017 (31 confirmed reports), but increased again in 2018 (46 confirmed reports; https://www.fisheries.noaa.gov/resource/document/2018-west-coast-whale-entanglement-summary). Nevertheless, all species of cetaceans may face threats from derelict fishing gear. The latest five-year average annual mortality related to fisheries interactions for the bowhead whale is less than one animal (Hayes et al. 2017a; Henry et al. 2017). Data represent only known mortalities and serious injuries; more, undocumented moralities and serious injuries within the action area have likely occurred.

In addition to these direct impacts, cetaceans may also be subject to impacts from fisheries. Marine mammals probably consume at least as much fish as is harvested by humans (Kenney et al. 1985). Many cetacean species (particularly fin and humpback whales) are known to feed on species of fish that are harvested by humans (Carretta et al. 2016). Thus, competition with humans for prey is a potential concern. Reductions in fish populations, whether natural or human-caused, may affect the survival and recovery of ESA-listed cetacean populations. Even species that do not directly compete with human fisheries could be affected by fishing activities through changes in ecosystem dynamics. However, in general the effects of fisheries on whales through changes in prey abundance remain unknown.

Ringed seals may be captured incidentally or as bycatch in commercial fisheries. Commercial fisheries may also affect ringed seals through competition for prey species that serve as prey for seals. Based on observer data from the Bering Sea-Aleutian Islands fisheries since the 1990s, trawl fisheries for pollock and flatfish resulted in the occasional incidental capture of one animal in some years but annual average mortality of ringed seals due to commercial fisheries were less than one animal (Kelly et al. 2010). Estimates of bycatch of ringed seals from other parts of the Arctic are not available but the distribution of ringed seals versus targeted fisheries have little overlap so bycatch levels are expected to be low (Kelly et al. 2010).

The U.S. fisheries in the North Pacific are managed to prevent overfishing of individual fish stocks, which is likely to reduce the potential effects to ringed seals associated with targeted fishing of prey species. Commercial fishing can affect prey characteristics because larger fish are targeted, often leading to population shifts toward reproduction at earlier ages and smaller sizes. Ringed seals seem to be adapted to existing variations in size and recruitment success of prey species so changes in prey sizes are not expected to have a significant impact on the seals unless fishing pressure increases (Kelly et al. 2010).

Monitoring of commercial groundfish trawl, longline, and pot fisheries in the Bering Sea-Aleutian Islands for bearded seals was conducted by shipboard observers in the 1990s and 2000s. During the 1990s, three years (1991, 1994, 1999) had more than one mortality per year observed in the groundfish trawl fishery but the mean annual mortality over this monitoring period was still less than one animal (Angliss and Lodge 2002). From 2000 – 2004, there was one mortality in two of the years (2000 and 2001) in the pollock trawl fishery for a mean annual mortality of less than one over the entire monitoring period (Angliss and Allen 2009). From 2002-2006, observer coverage was greater and incidental mortalities of bearded seals were again observed in the pollock trawl fishery; two in 2006 for a mean annual mortality of one animal during the monitoring period (Allen and Angliss 2010). During 2010-2014, incidental mortality and serious injury of bearded seals occurred in the Bering Sea/Aleutian Islands pollock trawl, Bering Sea/Aleutian Islands flatfish trawl, and Bering Sea/Aleutian Islands Pacific cod trawl fisheries (Muto et al. 2017b). The estimated mean annual mortality and serious injury rate incidental to U.S. commercial fisheries for bearded seals is 1.4 animals based on observer data.

Commercial fisheries target species that are known prey items of bearded seals. U.S. fisheries are managed to prevent overfishing of individual stocks and the overall biomass levels of groundfish species have remained relatively stable since the 1970s (Mueter and Megrey 2006). Bycatch of other bearded seal prey items in fisheries could also affect seals due to potential reductions in biomass of prey. Non-target bycatch species were found to be largely animals that are not prey items for bearded seals in the Bering Sea for which there are data on bycatch (Cameron et al. 2010).

Due to natural variations in size and recruitment of prey species, changes in size and age at reproduction induced by targeted fishing are not expected to have a significant impact on bearded seals that already respond to natural variation in prey species (Cameron et al. 2010). Groundfish trawling affects benthic habitat bearded seals use for foraging. In U.S. waters, modifications to trawl gear and restrictions in areas where groundfishing can be done are likely to minimize the potential impacts to bearded seals associated with habitat impacts from trawling (Cameron et al. 2010). In other areas, such as the southern North Sea, the trawling intensity is too high for biomass to recover with several areas being trawled seven times a year on average (Hiddink et al. 2006; Goñi 1998).

### 7.3 Whaling, Subsistence Hunting, and Cultural Resources

Large whale population numbers in the action area have historically been impacted by aboriginal hunting, though at levels that were likely too small to have population-level impacts, and early commercial exploitation, and some stocks were already reduced by 1864 (the beginning of the era of modern commercial whaling using harpoon guns as opposed to harpoons simply thrown by men). From 1864 through 1985, at least 2.4 million baleen whales (excluding minke whales [*Balaenoptera acutorostrata*]) and sperm whales were killed (Gambell 1999). The large number of baleen whales harvested during the 1930s and 1940s has been shown to correspond to increased cortisol levels in earplugs collected from baleen whales, suggesting that anthropogenic activities, such as those associated with whaling, may contribute to increased stress levels in whales (Trumble et al. 2018). Prior to current prohibitions on whaling most large whale species were significantly depleted to such an extent that it became necessary to list them as endangered under the Endangered Species Preservation Act of 1966. In 1982, the IWC issued a moratorium on commercial whaling beginning in 1986. There is currently no legal commercial whaling by IWC Member Nations party to the moratorium; however, whales are still killed commercially by countries that field objections to the moratorium (i.e., Iceland and Norway, and Japan beginning June 2019). Presently three types of whaling take place: (1) aboriginal subsistence whaling to support the needs of indigenous people; (2) special permit whaling; and (3) commercial whaling conducted either under objection or reservation to the moratorium. The reported catch and catch limits of large whale species from aboriginal subsistence whaling, special permit whaling, and commercial whaling can be found on the IWC's website at: https://iwc.int/whaling. In 2004, the U.S. Ninth Circuit Court of Appeals ruled that the Makah Indian Tribe, who requested authorization to hunt eastern North Pacific gray whales in traditional hunting grounds (rights included in the 1855 Treaty of Neah Bay), must comply with the MMPA process in order to pursue any treaty rights for whaling. On February 14, 2005, NMFS received a request from the Makah for a waiver of the MMPA's moratorium on take (defined as to harass, hunt, capture, or kill any marine mammal or attempt such actions under the MMPA). On April 15, 2019, NMFS published a proposed rule (84 FR 13604) to issue a waiver under the MMPA, including proposed regulations governing the hunting of eastern North Pacific gray whales by the Makah Tribe for a 10-year period and a related notive of hearing before an administrative law judge to consider the waiver and proposed regulations. Additionally, the Japanese whaling fleet carried out whale hunts under the guise of "scientific research," though very few peer-reviewed papers were published as a result of the program, and meat from the whales killed under the program was processed and sold at fish markets. This changed in June 2019 when Japan left the IWC and began commercially hunting whales, though this hunting is not occurring in Antarctic waters.

Norway and Iceland take whales commercially at present, either under objection to the moratorium decision or under reservation to it. These countries establish their own catch limits but must provide information on those catches and associated scientific data to the IWC. The Russian Federation has also registered an objection to the moratorium decision but does not exercise it. The moratorium is binding on all other members of the IWC. Norway takes minke whales in the North Atlantic Ocean within its EEZ, and Iceland takes minke whales and fin whales in the North Atlantic Ocean, within its EEZ (IWC 2012).

Under current IWC regulations, aboriginal subsistence whaling is permitted for Denmark (Greenland, fin and minke whales, *Balaenoptera* spp.), the Russian Federation (Siberia, gray [*Eschrichtius robustus*], and bowhead [*Balaena mysticetus*] whales), St. Vincent and the Grendaines (Bequia, humpback whales [*Megaptera novaeangliae*]), and the U.S. (Alaska, bowhead whales though an unauthorized gray whale harvest occurred in 2017). It is the responsibility of national governments to provide the IWC with evidence of the cultural and subsistence needs of their people. The Scientific Committee provides scientific advice on safe catch limits for such stocks (IWC 2012). Based on the information on need and scientific advice, the IWC then sets catch limits, recently in five-year blocks.

Prior commercial exploitation is likely to have altered population structure and social cohesion of bowhead whales within the action area, such that effects on abundance and recruitment continued for years after harvesting has ceased. Bowhead whale mortalities since 1985 resulting from subsistence whaling are estimated at 1,592 (IWC 2012).

Historically, commercial whaling caused all of the large whale species to decline to the point where they faced extinction risks high enough to list them as endangered species. Since the end of large-scale commercial whaling, the primary threat to the species has been eliminated. Many whale species have not yet fully recovered from those historic declines. Scientists cannot determine if those initial declines continue to influence current populations of most large whale species in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans. For example, the North Atlantic right whale has not recovered from the effects of commercial whaling and continue to face very high risks of extinction because of their small population sizes and low population growth rates. In contrast, populations of species such as the humpback whale have increased substantially from post-whaling population levels and appear to be recovering despite the impacts of vessel strikes, interactions with fishing gear, and increased levels of ambient sound.

Ringed seals have been an important subsistence resource for many Alaska Native communities along the coasts of the northern Bering, Chukchi, and Beaufort Seas but their harvest levels have decreased significantly since the 1970s (Kelly et al. 2010). Ringed seals are also hunted by Native communities in the Canadian Arctic for subsistence uses. Ringed seals are hunted commercially in Canada, Greenland, Svalbard, and Russia and hunted for sport in Norway (Kelly et al. 2010). Catches in the tens of thousands occur annually in Canada and Greenland. Catches in Svalbard and Norway are in the hundreds annually. Russia manages the harvest of ringed seals through a total annual catch system and issues permits to commercial and subsistence fishers. Catch limits vary with location with the largest harvests of thousands of seals allowed in the Bering and Chukchi Seas (Kelly et al. 2010).

Bearded seals have historically been an important subsistence resource for Native communities along the coasts of the northern Bering, Chukchi, eastern Siberian, and Beaufort Seas (Park 1999). Due to variations in reported harvest that may be due to changes in survey methodology, coverage, or reporting, it is not possible to accurately state the total number of bearded seals captured annually. However, based on the mean annual harvest reported from 1990-1998 and assuming 25-50 percent of seals struck are lost, Cameron et al. (2010) estimated the total annual hunt by Alaska Natives would range from 8,485 – 10,182 bearded seals. Information for 2009-2013 is available for 12 communities, although 50 other communities harvest bearded seals. Based on the harvest data from these 12 communities, a minimum estimate of the average annual harvest of bearded seals from 2009-2013 was 390 animals (Muto et al. 2017b). Total harvest of bearded seals by Siberian hunters in the Bering and Chukchi Seas is thought to have declined in the 1970s likely due to depletions from a growing commercial harvest in the 1960s and a shift to walrus hunting (Cameron et al. 2010). Bearded seal hunting is also important in the western Canadian Arctic where the Inuvialuit use bearded seals though the ringed seal harvest is more important (Cameron et al. 2010). It was estimated that an average of approximately 25 bearded seals were taken annually by Native subsistence hunters from 1988-1997 (IHSWG 2003).

### 7.4 Vessel Traffic and Tourism

Shipping activity in the Arctic is increasing as sea ice melts earlier and also due to oil and gas development in Alaska, Russia, and Norway and associated transport of these energy sources through the Arctic. This activity includes an increase in cruise ship traffic in addition to vessel traffic associated with the transport of goods such as oil and gas. Vessel traffic is also increasing in other portions of the action area as commercial shipping expands due to expansion of global markets, leading also to the construction of new ports and expansion of existing port facilities, often in areas containing ESA-listed species.

Vessels have the potential to affect animals through strikes, sound, and disturbance associated with their physical presence. Responses to vessel interactions include interruption of vital behaviors and social groups, separation of mothers and young, and abandonment of resting areas (Mann et al. 2000; Samuels et al. 2000; Boren et al. 2001; Constantine and Brunton 2001; Nowacek et al. 2004). Shipping activities pose a threat to ringed and bearded seals and bowhead whales due to the potential for oil spills. Acoustic impacts from sounds produced by vessels can also interrupt the normal behavior of animals that may also be disturbed by the presence of the ships themselves. Currently the use of icebreakers on the North Sea Route keeps shipping lanes in the Barents and Kara Seas open through pack ice at a time when bearded seals are hauling out in peak numbers to whelp and molt ( (O'Rourke 2010) and when ringed seals occupy subnivean lairs (Kelly et al. 2010). Segments of the Northwest Passage are used as ice conditions permit in the Canadian Arctic, confining most traffic to the late summer when seals are thought to be largely aquatic (Cameron et al. 2010). Tourism is a factor because the number of tour ships in Greenland, for example, has grown significantly and wildlife viewing occurs mainly in areas favored by species such as bearded seals during late whelping and molting (Cameron et al. 2010).

Vessel traffic in Alaska also includes the transportation of fuel in barges to small communities in northern and western Alaska. These shipments present a risk of large spills in remote areas without a lot of spill response capacity, which could have significant impacts to ESA-listed species and their habitat, including prey species.

Whale-watching tourism is rapidly growing worldwide and is expected to continue increasing. Vessels (both commercial and private) engaged in marine mammal watching also have the potential to impact marine mammals in the action areas. In 2009, it was estimated that whale-watching generated an estimated 2.1 billion ($US) based on data from 144 maritime countries worldwide of which 68 have invested in this industry (Cisneros-Montemayor et al. 2010). Studies have shown an alteration or cessation of essential behaviors, such as feeding or resting, which could reduce fitness in the long-term, especially when there is prolonged or repeated exposure (Parsons 2012). Short-term effects include changes in swimming behavior, such as deeper and more frequent dives, or fast changes in direction. The frequency and strength of animals' responses can also change with the number of vessels present, with a higher number of boats causing stronger responses (Stensland and Berggren 2007; New et al. 2015). Long-term effects are difficult to measure because whales and dolphins are long-lived and typically reproduce every one to five years, depending on the species. Where long-termed effects have been measured in a population, whale-watching activities have been linked to a decrease in population size (Lusseau 2006) or movement of animals out of the area (Bejder et al. 2006). However, other studies indicate that the disruption to feeding minke whales caused by whale-watching is unlikely to have a measurable impact on a female's repruductive success over time (Christiansen and Lusseau 2013).

Based on the data available from Douglas et al. (2008), Jensen and Silber (2004), and Laist et al. (2001), there have been at least 25 incidents in which marine mammals are known to have been struck by ships in the Puget Sound region and southwestern British Columbia. The marine mammals that were involved in almost half of these incidents died as a result of the strike and they suffered serious injuries in four of those strikes. Jensen and Silber (2004) reviewed data from 1975 to 2002 and found that nine cases of ship strike (6.7 percent) were USCG vessels. Laist et al. (2001) found that five of the ship strike cases they reviewed worldwide were caused by USCG patrol boats with two of the cases resulting in the death of the animal. These cases occurred off Delaware, Florida, Cape Cod, and the Kenai Peninsula, Alaska.

Virtually all of the rorqual whale species have been documented to have been hit by vessels. This includes blue whales (Berman-Kowalewski et al. 2010; Calambokidis 2012; Van Waerebeek et al. 2007), fin whales (in November 2011 in San Diego and in 2018 in Alaska, which likely resulted in mortality; (Douglas et al. 2008; Van Waerebeek et al. 2007), sei whales (Felix and Van Waerebeek 2005; Van Waerebeek et al. 2007), Bryde's whales (Felix and Van Waerebeek 2005; Van Waerebeek et al. 2007), minke whales (Van Waerebeek et al. 2007), humpback whales (Douglas et al. 2008; Lammers et al. 2003; Van Waerebeek et al. 2007), and bowhead whales (George et al. 2017). For example, in April 2013 in Burien, Washington and in June 2013 at Ocean City, Washington, two stranded fin whales that had been struck by vessels brought the total to nine known fin whale strikes in Washington in approximately the last decade (Schorr et al. 2013). Approximately two percent of the total number of bowhead whales harvested in Alaska between 1990 and 2012 had clear indications of injuries (e.g., propeller scars) consistent with vessel strikes (Muto et al. 2017b) based on whales harvested by permitted subsistence hunters.

In Alaska, large whales, such as fin whales and humpback whales, are occasionally found draped across the bow of large ships (https://alaskafisheries.noaa.gov/pr/strandings). From 2012 to 2016 there were 31 incidents of vessel strike reported in the NMFS Alaska Region stranding database. While this averages to just over 6 strikes reported a year, 2012 saw 10 reported strikes. From 1978-2011, 108 whale-vessel collisions were reported within 200 miles of Alaska's coastline (Neilson et al. 2012). Most of these (86 percent) were humpback whales. Other species included fin whale, Cuvier's beaked whale, Stejneger's beaked whale, gray whale, and beluga whale

(Neilson et al. 2012). In 15 of the 108 cases, whales struck anchored or drifting vessels, indicating that whales cannot always detect vessels (Neilson et al. 2012). In 2017, there were 7 reports of vessel strikes to humpback whales in Alaska, one of an unidentified cetacean, and one of a sperm whale, which was struck by a USCG cutter. The majority of marine mammal strandings in Alaska, which include vessel strikes, occur in the Bering Sea and Arctic for most cetaceans and ringed and bearded seals. Strandings of sperm whales, which included a vessel strike in 2017, were reported in the Gulf of Alaska only (Figure 4).

Collisions with commercial ships are an increasing threat to many large whale species, particularly as shipping lanes cross important large whale breeding and feeding habitats or migratory routes. The number of observed physical injuries to humpback whales as a result of ship collisions has increased in Hawaiian waters (Glockner-Ferrari et al. 1987; Lammers et al. 2007), possibly partly stemming from rapid humpback whale population growth. On the Pacific coast, a humpback whale is probably killed about every other year by ship strikes (Barlow et al. 1997). Through 2008, 82 instances of humpback whale shipstrike have been found (Gabriele et al. 2011). Ship strikes resulted in a minimum mean annual mortality and serious injury rate of 0.4 humpback whales from the Western North Pacific humpback stock from 2011-2015 (Muto et al. 2017b).

Due to the increasing abundance of humpback whales foraging in Alaska and the continued increase of marine traffic in Alaska's coastal waters, injury and mortality of humpback whales as a result of vessel strike are threats to the species (NMFS 2006). The potential for ship strikes also may increase as vessel traffic in northern latitudes increases with changes in sea-ice coverage (Muto et al. 2017b). Neilson et al. (2012) reviewed 108 whale-vessel collisions in Alaska from 1978-2011 and found that 86 percent involved humpback whales. Collision hotspots occurred in Southeast Alaska in popular whale-watching locations.

NMFS has promulgated regulations at 50 CFR §224.103 that specifically prohibit: (1) the negligent or intentional operation of an aircraft or vessel, or the doing of any other negligent or intentional act which results in disturbing or molesting a marine mammal; (2) feeding or attempting to feed a marine mammal in the wild; and (3) approaching humpback whales in Alaska waters closer than 100 yards (91.4 m). Now that the Hawaii DPS of humpbacks is delisted, MMPA regulations were promulgated to protect humpback whales by prohibiting operation of an aircraft within 1,000 ft (304.8 m) of a humpback whale; approaching within 100 yards (91.4 m) of a humpback whale by any means; causing a vessel, person, or other object to approach within 100 yards (91.4 m) of a humpback whale; or approaching a humpback whale by interception (i.e., placing an aircraft, vessel, person, or other object in the path of a humpback whale so that the whale approaches within a restricted distance; 81 FR 62010). In addition, NMFS launched an education and outreach campaign to provide commercial operators and the general public with responsible marine mammal viewing guidelines including: (1) remain at least 50 yards from dolphins, porpoise, seals, sea lions and sea turtles and 100 yards from large whales; (2) limit observation time to 30 minutes; (3) never encircle, chase, or entrap animals with boats; (4) place boat engine in neutral if approached by a wild marine mammal; (5) leave the water if approached while swimming; and (6) never feed wild marine mammals. In January 2002, NMFS also published an official policy on human interactions with wild marine mammals which states that: "*NOAA Fisheries cannot support, condone, approve or authorize activities that involve closely approaching, interacting or attempting to interact with whales, dolphins, porpoises, seals or sea lions in the wild. This includes attempting to swim with, pet, touch or elicit a reaction from the animals.*"

Although considered by many to be a non-consumptive use of marine mammals with economic, recreational, educational, and scientific benefits, marine mammal watching is not without potential negative impacts. One concern is that animals may become more vulnerable to vessel strikes once they habituate to vessel traffic. Another concern is that preferred habitats may be abandoned if disturbance levels are too high, which has been documented such as in a study of bottlenose dolphins (Bejder et al. 2006).

Numerous studies of interactions between surface vessels and marine mammals have demonstrated that free-ranging marine mammals engage in avoidance behavior when surface vessels move toward them. It is not clear whether these responses are caused by the physical presence of a surface vessel, the underwater noise generated by the vessel, or an interaction between the two (Goodwin and Cotton 2004; Lusseau 2006). However, several authors suggest that the noise generated during motion is probably an important factor (Blane and Jaakson 1994; Evans et al. 1992; Evans et al. 1994). These studies suggest that the behavioral responses of marine mammals to surface vessels are similar to their behavioral responses to predators.

Several investigators have studied the effects of whale watch vessels on marine mammals (Amaral and Carlson 2005; Au and Green 2000; Christiansen et al. 2011; Christiansen et al. 2013; Corkeron 1995; Erbe 2002b; Félix 2001; Magalhaes et al. 2002; May-Collado et al. 2014; Richter et al. 2006; Scheidat et al. 2004; Simmonds 2005; Watkins 1986; Williams et al. 2002b), including one targeting the response of humpback whales to whale-watching vessels in Juneau, Alaska (Schuler et al. 2019). The whale's behavioral responses to whale-watching vessels depended on the distance of the vessel from the whale, vessel speed, vessel direction, vessel noise, and the number of vessels. Responses changed with these different variables and, in some circumstances, the whales or dolphins did not respond to the vessels, but in other circumstances, whales changed their vocalizations, surface time, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions, and dolphins abandoned important habitats due to long-terms disturbance (Bejder et al. 2006).

### 7.5 Water Quality Degradation

Exposure to pollution and contaminants have the potential to cause adverse health effects in marine species. Marine ecosystems receive pollutants from a variety of local, regional, and international sources, and their levels and sources are therefore difficult to identify and monitor (Grant and Ross 2002). Marine pollutants come from multiple municipal, industrial, and household as well as from atmospheric transport (Iwata et al. 1993; Grant and Ross 2002; Garrett

2004; Hartwell 2004). Contaminants may be introduced by rivers, coastal runoff, wind, ocean dumping, dumping of raw sewage by boats and various industrial activities, including offshore oil and gas or mineral exploitation (Grant and Ross 2002; Garrett 2004; Hartwell 2004). The action area includes ports and harbors in coastal areas, which are often some of the most highly developed lands in the U.S. and elsewhere.

The accumulation of persistent organic pollutants, including polychlorinated-biphenyls, dibenzo-p-dioxins, dibenzofurans, and related compounds, through trophic transfer may cause mortality and sub-lethal effects in long-lived higher trophic level animals (Waring et al. 2016), including immune system abnormalities, endocrine disruption, and reproductive effects (Krahn et al. 2007). Persistent organic pollutants may also facilitate disease emergence and lead to the creation of susceptible “reservoirs” for new pathogens in contaminated marine mammal populations (Ross 2002). Efforts since 2000 have led to improvements in regional water quality and monitored pesticide levels have declined, although the more persistent chemicals are still detected and are expected to endure for years (Mearns 2001; Grant and Ross 2002).

Numerous factors can affect concentrations of persistent pollutants in marine mammals, such as age, sex, birth order, diet, and habitat use (Mongillo et al. 2012). In marine mammals, pollutant contaminant load for males increases with age, whereas females pass on contaminants to offspring during pregnancy and lactation (Addison and Brodie 1987; Borrell et al. 1995). Pollutants can be transferred from mothers to juveniles at a time when their bodies are undergoing rapid development, putting juveniles at risk of immune and endocrine system dysfunction later in life (Krahn et al. 2009).

Some environmental contaminants, such as chlorinated pesticides, are lipophilic and can be found in the blubber of marine mammals (Becker et al. 1995). Bowhead whale blubber and some organs were collected during subsistence hunts from 1997-1999 at Barrow, Alaska to measure concentrations of persistent organochlorine contaminants (Hoekstra et al. 2005). Concentrations in bowhead whale tissues were correlated with lipid content. Relatively higher proportions of hexachlorocyclohexane (also known as benzene hexachloride) isomers (eight chemical forms of this synthetic chemical, some of which were used as insecticides) were observed in bowhead whale heart and diaphragm samples than in other tissues (Hoekstra et al. 2005). Bratton et al. (1993) measured organic arsenic in the liver tissue of one bowhead whale and found that about 98 percent of the total arsenic was arsenobetaine. Arsenobetaine is a common substance in marine biological systems and is relatively non-toxic.

Bratton et al. (1993) looked at eight metals (arsenic, cadmium, copper, iron, mercury, lead, selenium, and zinc) in the kidneys, liver, muscle, blubber, and visceral fat from bowhead whales harvested from 1983 to 1990. They observed considerable variation in tissue metal concentration among the whales tested. Metal concentrations evaluated did not appear to increase over time. The metal levels observed in all tissues of the bowhead are similar to levels reported in the literature in other baleen whales. The bowhead whale has little metal contamination as compared to other Arctic marine mammals, except for cadmium. Mossner and Ballschmiter (1997) reported that total levels of polychlorinated biphenyls and chlorinated pesticides in bowhead blubber from the North Pacific and Arctic Oceans were many times lower than those in beluga whales or northern fur seals. However, while total levels were low, the combined level of three isomers of the hexachlorocyclohexanes (chlorinated pesticides) was higher in the blubber tested from bowhead whales than from three marine mammal species sampled in the North Atlantic (pilot whale, common dolphin, and harbor seal). These results were believed to be due to the lower trophic level of the bowhead as compared to the other marine mammals tested.

Heavy metals such as mercury, selenium, cadmium, and zinc have been reported in the tissues of ringed seals, particularly liver, kidney and muscle tissue, from different locations in the Arctic (Kelly et al. 2010). Toxic effects of heavy metal concentrations were not detected, however. Organochlorine pollutants, including compounds such as DDT and PCBs, have been reported in ringed seals. Concentrations increased with age in males but were reduced in nursing females due to transfer of contaminants to nursing pups (Kelly et al. 2010). Concentrations of some of these pollutants in Arctic ringed seals did not change between 1981 and 2000 according to Addison et al. (2005). Perfluorinated contaminants (PFCs), used in many industrial products such as fire retardants, insecticides and herbicides, lubricants, adhesives, and paints, have been detected in ringed seals in the Alaskan Bering and Chukchi Seas (Quakenbush and Citta 2008). The contaminants did not appear to bioaccumulate with age in male or female seals (Quakenbush and Citta 2008). Kelly et al. (2010) concluded that pollution poses a low to moderate threat to ringed seals, particularly given that levels of organochlorines are expected to continue increasing and climate change has the potential to increase the transport of pollutants from lower latitudes to the Arctic.

Bearded seals bioaccummulate mercury in tissues and rates of accumulation appear to be somewhat higher than in ringed seals (Smith and Armstrong 1978). Toxic effects of this bioaccumulation were not reported. Organochlorine compounds and heavy metals have been found in most bearded seal populations that have been studied though research on contaminants and bearded seals is limited compared to ringed seals (Cameron et al. 2010). Of six marine mammals tested in Alaska, bearded seals had the highest concentrations of DDT (Kelly 1988). Dieldrin and lindane were found in bearded seals though at less than half the concentration of DDT (Galster and Burns 1972). PFCs and related synthetic compounds have also been detected in bearded seals in the western Arctic (Powley et al. 2008). There are high concentrations of organochlorine compounds in the blubber of male bearded seals, particularly from Alaska and the White Sea, in comparison to other areas where samples were collected are reported (Muir et al. 2003; Bang et al. 2001; Quakenbush et al. 2010a). Cameron et al. (2010) concluded that pollution poses a low to moderate threat to bearded seals particularly given the potential for increased input of pollutants to the marine environment through freshwater runoff.

### 7.6 Ocean Noise

Much of the increase in sound in the ocean environment is due to increased shipping, as vessels become more numerous and of larger tonnage (NRC 2003; Hildebrand 2009; McKenna et al.

2012). Commercial shipping continues to be a major source of low-frequency sound in the ocean, particularly in the Northern Hemisphere where the majority of vessel traffic occurs. Although large vessels emit predominantly low frequency sound, studies report broadband sound from large cargo vessels above 2 kHz. The low frequency sounds from large vessels overlap with many mysticetes' predicted hearing ranges (7 Hz to 35 kHz; NOAA 2018) and may mask their vocalizations and cause stress (Rolland et al. 2012). The broadband sounds from large vessels may interfere with important biological functions of odontocetes, including foraging (Holt 2008; Blair et al. 2016). At frequencies below 300 Hz, ambient sound levels are elevated by 15 to 20 dB when exposed to sounds from vessels at a distance (McKenna et al. 2013). Analysis of sound from vessels revealed that their propulsion systems are a dominant source of radiated underwater sound at frequencies less than 200 Hz (Ross 1976). Additional sources of vessel sound include rotational and reciprocating machinery that produces tones and pulses at a constant rate. Other commercial and recreational vessels also operate within the action area and may produce similar sounds, although to a lesser extent given their much smaller size.

Individual vessels produce unique acoustic signatures, although these signatures may change with vessel speed, vessel load, and activities that may be taking place on the vessel. Peak spectral levels for individual commercial vessels are in the frequency band of 10 to 50 Hz and range from 195 dB re: $\mu Pa^2$-s at 1 m sound exposure level (SEL) for fast-moving (greater than 37 kilometers per hour [20 knots]) supertankers to 140 dB re: $\mu Pa^2$-s at 1 m SEL for small fishing vessels (NRC 2003). Small boats with outboard or inboard engines produce sound that is generally highest in the mid-frequency (1 to 5 kHz) range and at moderate (150 to 180 dB re: 1 µPa at 1 m rms) source levels (Erbe 2002b; Gabriele et al. 2003; Kipple and Gabriele 2004). On average, sound levels are higher for the larger vessels, and increased vessel speeds result in higher sound levels. Measurements made over the period 1950 through 1970 indicated low frequency (50 Hz) vessel traffic sound in the eastern North Pacific Ocean and western North Atlantic Ocean was increasing by 0.55 dB per year (Ross 1976;1993;2005). Whether or not such trends continue today is unclear. Most data indicate vessel sound is likely still increasing (Hildebrand 2009). However, the rate of increase appears to have slowed in some areas (Chapman and Price 2011), and in some places, ambient sound including that produced by vessels appears to be decreasing (Miksis-Olds and Nichols 2016). Efforts are underway to better document changes in ambient sound (Haver et al. 2018), which will help provide a better understanding of current and future impacts of vessel sound on ESA-listed species.

Sonar systems are used on commercial, recreational, and military vessels and may also affect cetaceans (NRC 2003). Although little information is available on potential effects of multiple commercial and recreational sonars to cetaceans, the distribution of these sounds would be small because of their short durations and the fact that the high frequencies of the signals attenuate quickly in seawater (Nowacek et al. 2007). However, military sonar, particularly low frequency active sonar, often produces intense sounds at high source levels, and these may impact cetacean behavior (Southall et al. 2016).

Aircraft within the action area may consist of small commercial or recreational airplanes, helicopters, to large commercial airliners. These aircraft produce a variety of sounds that could potentially enter the water and impact marine mammals. While it is difficult to assess these impacts, several studies have documented what appear to be minor behavioral disturbances in response to aircraft presence (Nowacek et al. 2007).

There are seismic survey activities involving towed airgun arrays that may occur within the action area. They are the primary exploration technique to locate oil and gas deposits, fault structure, and other geological hazards. These activities may produce noise that could impact ESA-listed cetaceans and sea turtles within the action area. These airgun arrays generate intense low-frequency sound pressure waves capable of penetrating the seafloor and are fired repetitively at intervals of ten to 20 seconds for extended periods (NRC 2003). Most of the energy from the airguns is directed vertically downward, but significant sound emission also extends horizontally. Peak SPLs from airguns usually reach 235 to 240 dB at dominant frequencies of five to 300 Hz (NRC 2003). Most of the sound energy is at frequencies below 500 Hz, which is within the hearing range of baleen whales (Nowacek et al. 2007).

Exposure to hydrocarbons released into the environment via oil spills and other discharges pose risks to marine species. Marine mammals are generally able to metabolize and excrete limited amounts of hydrocarbons, but exposure to large amounts of hydrocarbons and chronic exposure over time pose greater risks (Grant and Ross 2002). Acute exposure of marine mammals to petroleum products causes changes in behavior and may directly injure animals (Geraci 1990). More recent studies to understand impacts on bottlenose dolphins conducted over a five year period following the Deepwater Horizon oil spill show dolphins from the most heavily oiled coastal areas have had chronic poor health, failed pregnancies, and increasd mortality from inhalation and other exposure to oil (Schwacke et al. 2014; Venn-Watson et al. 2015; Litz et al. 2014).

The southeast region of Alaska has the the greatest number of reported oil and other hazardous substance spills in marine waters between 1995 and 2012. However, the greatest volume of spills during this same time period occurred in the Aleutian Islands region. The Northwest Arctic and Western Alaska regions reported very few spills >100 gallons (2 and 6, respectively), likely due to a lack of reporting, low human population density, and lack of major development. Cook Inlet is the only region to report crude oil spills during the 1995-2012 time period (NMFS 2015c).

Marine construction in the action area that produces sound includes drilling, dredging, pile-driving, cable-laying, and explosions. These activities are known to cause behavioral disturbance and physical damage (NRC 2003). While most of these activities are coastal, offshore construction does occur.

In 2016, NMFS Alaska Region conducted internal consultations with NMFS Permits and Conservation Division on the issuance of three IHAs to take marine mammals incidental to dock construction, fiber optic cable laying, and anchor retrieval in the Bering, Chukchi, and Beaufort Seas, during the 2016 open water season. The incidental take statements issued with the three biological opinions exempted take (by harassment) of 788 bowhead whales, 19 fin whales, 13 humpback whales, 706 bearded seals, 7,887 ringed seals, and 2,185 Western DPS Steller sea lions, as a result of exposure to continuous or impulsive sounds at received levels at or above 120 dB or 160 dB re: 1 μPa rms respectively. Fiber optic cable laying continued in 2017, and NMFS Alaska Region also conducted a consultation with NMFS Permits and Conservation Division on the issuance of an IHA for this project. Quintillion was permitted to install 1,904 km (1,183 mi) of subsea fiber optic cable during the open-water season, including a main trunk line and six branch lines to onshore facilities in Nome, Kotzebue, Point Hope, Wainwright, Utqiagvik/Barrow, and Oliktok Point (Liberty Development and Production Plan Biological Opinion PCTS AKR-2018-9747). The incidental take statement issued with the biological opinion exempted take (by harassment) of 314 bowhead whales, 15 fin whales, 3 Western North Pacific DPS humpback whales, 7 Mexico DPS humpback whales, 62 bearded seals, 855 ringed seals, and 8 Western DPS Steller sea lions, total, as a result of exposure to sounds of received levels at or above 120 dB re: 1 μPa rms from sea plows, anchor handling, and operation and maintenance activities (NMFS 2018c).

### 7.7 Oil and Gas Activities

In the U.S., oil and gas activities have been conducted off the coast of Alaska since the 1970s with highest activity levels in the Beaufort Sea. There are active oil fields in the Beaufort Sea. In the Chukchi Sea, exploratory wells have been drilled but there are no oil fields to date. These activities are expected to continue and may even increase in the future if melting ice makes oil reserves more accessible. There are no offshore oil or gas fields in development or production in the Bering Sea. Oil and gas exploration, development, and production activities include seismic surveys, drilling operations, fill placement, pipeline and shoreline facility construction, and vessel and aircraft operations.

Oil and gas exploration, development, and production activities have the potential to impact ringed seals through noise, physical disturbance, and pollution caused by these activities, particularly when an accident occurs (Kelly et al. 2010). In a study by Harwood et al. (2007) evaluating the potential impacts of exploratory drilling on ringed seals in the nearshore Canadian Beaufort Sea, seal breathing holes and lairs were not significantly different in distance from industrial activities during pre and post-drilling years. Similarly, the movements, behavior, and home range size of tagged seals did not vary statistically during and post-drilling activity (Harwood et al. 2007). Moulton et al. (2005) reported that there was no evidence of a change in local ringed seal distribution and numbers during the construction, drilling and production activities associated with BP's Northstar oil development in the Beaufort Sea based on spring aerial surveys of seals. Richardson and Williams (2004) also concluded there was little effect on ringed seals during their open-water period from the low to moderate level, low frequency industrial sounds emanating from the Northstar facility due to drilling and construction at the Northstar facility. However, Northstar is a man-made island and some of the results may not be applicable to other facilities (Kelly et al. 2010).

Disturbance, injury, or mortality from oil spills and/or other discharges associated with oil and gas activities are considered to be moderately significant threats to the Beringia and Okhotsk DPSs of bearded seals (Cameron et al. 2010). Oil spills would be difficult to clean up in the Arctic due to issues such as access and effectiveness of cleanup technologies. Bearded seal pups are not fully molted at birth and would be particularly prone to physical impacts from oiling. Seals could also be affected by oil exposure leading to skin irritation, disorientation, lethargy, conjunctivitis, corneal ulcers, and liver lesions, as well as due to inhalation of vapors. Bearded seals are benthic foragers and could be affected by ingestion of contaminated prey. Spilled oil can cause disruptions in benthic communities and transfer of contaminants through the food web (Stowasser et al. 2004) with colder climates making these effects last longer. Threats to bearded seals from oil and gas activities are greatest where activities converge with breeding aggregations or migratory corridors such as the Bering Strait (Cameron et al. 2010) where these activities are considered a moderate threat.

Similarly, bowhead whales could be affected by oil spills and other discharges associated with oil and gas activities, as well as noise and physical disturbance and impacts to prey species. Copepods and other small planktonic organisms on which these and other ESA-listed whales prey are highly susceptible to spills.

Other portions of the action area where species such as fin and humpback whales are also present have oil and gas development, such as the Gulf of Mexico, which may be along the transit routes for new icebreakers if the shipbuilding facility or facilities for their construction is located in the Gulf.

## 7.8 Scientific Research

Regulations for section 10(a)(1)(A) of the ESA allow issuance of permits authorizing take of certain ESA-listed species for the purposes of scientific research. Prior to the issuance of such a permit, the proposal must be reviewed for compliance with section 7 of the ESA. Marine mammals have been the subject of field studies for decades. The primary objective of most of these field studies has generally been monitoring populations or gathering data for behavioral and ecological studies. Over time, NMFS has issued dozens of permits on an annual basis for various forms of “take” of marine mammals in the action area from a variety of research activities.

Authorized research on ESA-listed marine mammals includes aerial and vessel surveys, close approaches, photography, videography, behavioral observations, active acoustics, remote ultrasound, passive acoustic monitoring, biological sampling (i.e., biopsy, breath, fecal, sloughed skin), and tagging. Research activities involve non-lethal “takes” of these marine mammals.

There have been numerous research permits issued since 2009 under the provisions of both the MMPA and ESA authorizing scientific research on marine mammals all over the world, including for research in the action area. The completed ESA section 7 consultations for the issuance of these ESA scientific research permits concluded that the authorized research activities will have no more than short-term effects and will not result in jeopardy to the species nor destruction or adverse modification of designated critical habitat. However, cumulatively there may be some effects to species given that many of the studies target the same populations due to overlapping action areas. Currently 58 permits allow research on a combination of cetaceans and pinnipeds in areas that could overlap with the action area.

Ringed and bearded seals have been collected occasionally for zoos and aquaria or killed for scientific research. Total numbers of seals collected are not known but are believed to be small and likely not to affect populations of any of the subspecies of ringed seals or populations of bearded seals (Kelly et al. 2010; Cameron et al. 2010).

In addition to directed take, a number of research permits and associated section 7 consultations allow for incidental take of marine mammals, including whales and ice seals, from harassment associated with research activities targeting other species or a specific number of individuals from the same species.

### 7.9 Military Training and Testing

The Navy has been conducting exercises in the Northwest Training and Testing (NWTT) Action Area off the coast of Washington for over 60 years. In terms of surface combatant ships, currently there are two aircraft carriers and five Navy destroyers home-ported at naval facilities within Puget Sound. Monitoring in conjunction with Navy exercises to determine the effects of active sonar and explosives on marine mammals was initiated in 2010 as part of the MMPA regulations that allowed NMFS to issue Letters of Authorization (LOAs) for Navy military readiness activities in the Northwest Training Range Complex (NWTRC). Stranding data has been collected by researchers in the NWTRC for approximately 30 years as well as by NMFS for roughly 22 years. Though not all dead or injured marine mammals can be accounted for, if marine mammals were being harmed by the Navy training exercises in the NWTRC with any regularity, evidence of that harm would likely have been detected over the 30-year period. Under the NMFS MMPA Rule and LOA for NWTT, incidental take is authorized for certain whale species in the Pacific Northwest. Authorized MMPA and ESA incidental take due to behavioral harassment was exceeded for humpback, fin, sperm, and killer whales by 4 to 19 takes depending on the species from 2012 to 2014 mainly due to sonar operations but in a few cases, due to the use of explosives (NMFS 2015b).

In the winters of 2014, 2017, and 2018, the U.S. Navy also conducted submarine training, testing, and research activities in the northern Beaufort Sea and Arctic Ocean from a temporary camp constructed on an ice flow toward the northern extent of the EEZ, about 185 to 370 km (115 to 230 mi) north of Prudhoe Bay. Equipment, materials, and personnel were transported to and from the ice camp via daily flights based out of the Deadhorse Airport (located in Prudhoe Bay).

The U.S. Navy also regularly conducts training and testing activities in ranges located in other portions of the action area such as off the coast of Florida, the Northeast Atlantic, and in the

Pacific Islands with similar potential for impacts to ESA-listed species, particularly marine mammals such as fin and humpback whales.

### 7.10 Predation

Within the Artic operation area, the only known predators of bowhead whales are transient killer whales (Muto et al. 2017b). Using 378 records from 1990 to 2012, George et al. (2017) observed scarring "rake marks" consistent with injuries inflicted from killer whales on 30 bowhead whales. In addition, two out of approximately 11 bowhead whale carcasses seen during the Aerial Survey of Arctic Marine Mammals project in 2015 exhibited clear evidence of killer whale predation, including rake marks and a missing jaw/tongue (Suydam et al. 2016). Killer whales prey on other whale species as well, particularly calves, including in other portions of the action area where species such as fin and humpback whales are present during different parts of the year.

Different life stages of Arctic ringed seals serve as prey species for polar bears, Arctic foxes, walruses, killer whales, Greenland sharks, common ravens, and glaucous gulls (Kelly et al. 2010). Ringed and bearded seals are the primary prey of polar bears (Heptner et al. 1976a;b; Derocher et al. 2004). In the Beaufort Sea, ringed seals make up 98 percent of polar bear diets (Kelly et al. 2010). Kelly et al. (2010) concluded that predation poses a medium to high threat to ringed seals given their importance to the diet of polar bears and because climate change could lead to greater exposure to predators if snow continues to melt early.

Polar bears are the primary predators of bearded seals but the remains of bearded seals have also been found in the stomach contents of walruses and killer whales (Cameron et al. 2010). The predicted reduction in seasonal sea ice is likely to reduce predation by polar bears but could lead to increased predation by walruses and killer whales, as well as possible predation on pups by wolves, foxes, and bears (Cameron et al. 2010). Overall, predation currently does not pose a significant threat to bearded seals at present.

### 7.11 Synthesis of Baseline Impacts

Collectively, the stressors described above have had, and are likely to continue to have, lasting impacts on fin, bowhead, and humpback (Western North Pacific and Mexico DPSs) whales, ringed seal Arctic subspecies, bearded seal Beringia DPS, and ringed seal Arctic subspecies proposed critical habitat within the action area. Some of these stressors result in mortality or serious injury to individual animals (e.g., vessel strikes, whaling, and subsistence hunting), whereas others result in more indirect (e.g., water quality degradation) or non-lethal (e.g., whale-watching) impacts.

We consider the best indicator of the aggregate impact of the *Environmental Baseline* on ESA-listed resources to be the status and trends of those species. As noted in Section 6.2, some of the species considered in this consultation are experiencing increases in population abundance, some are declining, and for others, their status remains unknown. Taken together, this indicates that the *Environmental Baseline* is impacting species in different ways. The species experiencing increasing population abundances are doing so despite the potential negative impacts of the *Environmental Baseline*. Therefore, while the *Environmental Baseline* may slow their recovery, recovery is not being prevented. For the species that may be declining in abundance, it is possible that the suite of conditions described in the *Environmental Baseline* is preventing their recovery. However, is also possible that their populations are at such low levels (e.g., due to historical commercial whaling) that even when the species' primary threats are removed, the species may not be able to achieve recovery. At small population sizes, species may experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their limited population size to become a threat in and of itself. A thorough review of the status and trends of each species is discussed in the *Status of Species and Critical Habitat Likely to be Adversely Affected* (Section 6.2) section of this Opinion.

# 8 EFFECTS OF THE ACTION

"Effects of the action" has been recently revised to mean all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur (50 C.F.R. §402.02). Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 C.F.R. §402.17).

This effects analysis section is organized following the stressor, exposure, response, risk assessment framework.

## 8.1 Extremely Unlikely to Occur and Insignificant Effects

The effects of noise generated by vessel transit (for icebreakers and small vessels) and the use of navigational equipment were analyzed in Section 6.1.1. This analysis of noise from vessel transit and the use of navigational equipment in the action area found the effects of this noise to be insignificant for ESA-listed species for which all effects of the proposed action were determined not to result in adverse effects. We believe the effects of noise from vessel operation and the use of navigation equipment and vessel strikes on bowhead, fin, and humpback (Western North Pacific and Mexico DPSs) whales, and ringed (Artic subspecies) and bearded (Beringia DPS) seals are also not likely to result in adverse effects for the reasons detailed in Section 6.1.1 and will not repeat the analysis here.

In this section, we discuss the potential effects of other activities that will occur in the action area that are expected to result in stressors affecting bowhead, fin, and humpback (Western North Pacific and Mexico DPSs) whales, ringed (Arctic subspecies) and bearded (Beringia DPS) seals, and ringed seal Arctic subspecies proposed critical habitat.

As discussed in Section 6.1.2, maneuverability testing consisting of propulsion testing during post-delivery and sea trials, diver training and operations, gunnery training, and marine environmental response training will take place in the Pacific Northwest operation area. As for the ESA-listed marine mammals considered in Section 6.1, we believe the effects of exposure to stressors resulting from gunnery training noise and expended materials, potential discharges to marine waters associated with dive training and operations, vessel movement during propulsion testing, and the deployment of boom and use of support vessels during environmental response training will be extremely unlikely to occur for fin and humpback (Western North Pacific and Mexico DPSs) whales. We make this determination for the same reasons discussed in Sections 6.1.1 and 6.1.2 for other ESA-listed whale species that may be present in the Pacific Northwest operation area during implementation of the activities proposed in this operation area. Therefore, the activities proposed in the Pacific Northwest operation area are not likely to adversely affect fin and humpback whales. The activities in the Pacific Northwest operation area will have no effect on bowhead whales, ringed seals (Arctic subspecies), bearded seals (Beringia DPS), or proposed ringed seal critical habitat because these species and habitat are not present in the Pacific Northwest operation area.

As discussed in Section 6.1.4, in the Antarctic operation area, activities that are part of the action include icebreaking at full and quarter power; vessel escort; vessel tow; passenger and science transfer; search and rescue training; diver training and operations; fueling underway; and helicopter operations for daytime landing qualifications, ice reconnaissance, vertical replenishment and mission support, and passenger and science transfer. As for the ESA-listed whales discussed in Section 6.1.4, fin whales will be present in Antarctica during the austral summer when the proposed activities will take place. As discussed in Section 6.1.4, previous consultations have determined that icebreaking activities associated with seismic surveys in the Ross Sea would result in the movement of ESA-listed whales out of the area in response to temporary disturbances created by icebreaking and the use of support vessels and aircraft. The temporary disturbance of fin whales to other portions of the Ross Sea would result in temporary suspension of feeding and other behaviors but, given the extent of habitat available to whales and the apparent prefence of these animals for areas along borders of the Ross Ice Shelf, we expect any effects from exposure of these stressors to be unlikely and therefore extremely unlikely to occur. Therefore, the action is not likely to adversely affect fin whales in the Antarctic operation area. The activities in the Antarctic operation area will have no effect on bowhead whales, ESA-listed DPSs of humpback whales considered in this Opinion, ringed seals, bearded seals, or proposed critical habitat for ringed seals because these species and habitat are not present in the Antarctic operation area.

The discussion in Section 6.1.5 regarding the potential stressors to ESA-listed species and designated critical habitats from the use of Puget Sound, Seattle as the homeport for the new icebreakers applies to humpback whales (see Section 6.2.3), which have been reported infrequently in the Puget Sound area, including near military bases where the icebreakers would port. We believe the effects of exposure to stressors resulting from ship husbandry and maintenance as part of dive training and operations and from ship transit and mooring at the homeport will be extremely unlikely to occur for humpback and fin whales for the same reasons as described in Sections 6.1.1 and 6.1.5 for other ESA-listed whale species. Therefore, the use of

Seattle as a homeport for the new icebreakers is not likely to adversely affect humpback and fin whales. The use of the Seattle homeport will have no effect on bowhead whales, ringed seals (Arctic subspecies), bearded seals (Beringia DPS), or proposed ringed seal critical habitat because these species and habitat are not present in the Puget Sound area.

In terms of the use of UASs to perform ice reconnaissance instead of or in support of helicopters in the Arctic and Antarctic operation areas, Christiansen et al. (2016) found the noise of UASs could only be quantified above background noise of the recording sites at 1 m depth when flying at altitudes of 5 and 10 m. The frequencies at which UASs operate are also likely to be below the hearing thresholds at low frequencies of toothed whales (Table 4; Christiansen et al. (2016). In comparison to helicopters, the small size of UASs and quieter engines are likely to result in significantly less disturbance of marine mammals, if any. Acevedo-Whitehouse et al. (2010) used unmanned aircraft systems at 13 m (42.7 ft) altitude over blue, gray, humpback, and sperm whales, and observed no avoidance behaviors. Koski et al. (2015) used unmanned aircraft systems over bowhead whales at 120 m (393.7 ft) altitude with no behavioral responses noted. Three recent reviews covering the potential impacts of unmanned aerial systems on marine mammals found no data to indicate that ESA-listed cetaceans behaviorally respond to unmanned aircraft systems (Christie et al. 2016; Marine Mammal Commission 2016; Smith et al. 2016). However, in a recent report submitted to NMFS for MMPA Permit No. 18636, researchers documented behavioral responses by large whales when unmanned aircraft systems were flown at a height of approximately 3.7 m (12 ft) over the animals (NMFS 2017). These responses consisted of mild, short-term changes in behavior such as cetaceans rolling over to view the unmanned aircraft systems, or “bucking” before returning to pre-exposure behavior.

In the Arctic operation area, helicopter operations for passenger transfer and mission support; marine environmental response training; fueling underway; diver training and operations; bollard condition testing; vessel operations for passenger transfer; UAS use for ice reconnaissance and law enforcement; and AUV deployment in ice are considered stressors that will have minimal impacts on ESA-listed species in this area. There will be 96 hours of AUV use per year; up to 4 hours of UAS use for ice reconnaissance; 60 hours of icebreaker and small boat operations for activities including passenger transfer, mission support, and environmental response training; 2 hours of bollard condition testing (at a pier) once every 10 years; and up to 32 hours of helicopter operation for passenger transfer and mission support per year. There will be additional hours of icebreaker operation associated with transit during patrols and to and from homeport and operation areas. We believe the effects of stressors from helicopter operations for passenger transfer and mission support; marine environmental response training; fueling underway; diver training and operations; bollard condition testing; vessel operations for passenger transfer; UAS operation for ice reconnaissance and law enforcement; and AUV deployment in ice, as well as vessel transit, will be extremely unlikely to occur for fin whales, humpback (Western North Pacific and Mexico DPSs) whales, ringed (Arctic subspecies) seals, bearded (Beringia DPS) seals, and proposed critical habitat for Arctic ringed seals will be extremely unlikely to occur. We make this determination for the same reasons discussed in Sections 6.1.1 and 6.1.3 for other

ESA-listed marine mammals that may be present in the Arctic operation area during implementation of the specific activities noted here, including due to implementation of the PDCs to minimize the risk of disturbance from these activities to ESA-listed species and their habitat. Therefore, helicopter operations for passenger transfer and mission support; marine environmental response training; fueling underway; diver training and operations; bollard condition testing; vessel operations for passenger transfer; UAS use for ice reconnaissance and law enforcement; and AUV deployment in ice proposed in the Arctic operation area are not likely to adversely affect fin and humpback whales, ringed and bearded seals, and proposed critical habitat for Arctic ringed seals.

## 8.2 Key Assumptions Underlying the Estimation of Effects

Because this is a mixed programmatic action with a number of unknowns as the PSC Program evolves and new icebreakers are constructed, we made several assumptions to complete our effects analysis. Key assumptions discussed below were the locations and timing of activities involving icebreaking in relation to ESA-listed marine mammals in the Arctic operation area, the location of the homeport for the new icebreakers, and the definition of "harass" related to ESA-listed marine mammals.

### 8.2.1 Location and Timing of Icebreaking Activities in the Arctic and Homeport Location

Our analysis is based on past and ongoing icebreaking operations in the Arctic conducted by the USCG to maintain navigation routes through the Northwest Passage and an opening of ice in the Northern Sea Route (Figure 14) through the Bering Strait, including to support scientific missions in the Arctic in waters of the Bering, Chukchi, and Beaufort Seas. Icebreaking activities currently occur from March to September as ice melts in summer. Thus, the number of activities and total hours of icebreaking expected to support the USCG mission are based on current conditions and operations and are expected to be most frequent during spring through fall, though the timing depends on ice extent. As sea ice changes, icebreakers may operate year-round in the Arctic and the number and type of activities and total hours of icebreaking could increase, particularly given that the design lifetime of each icebreaker is 30 years. Assuming a total of 6 vessels are constructed as planned, and given the timing of construction for each with one vessel constructed per year, the first vessel ready in 2023, and 1.5 to 2 years for completion of each vessel, we have determined the consultation must cover a 40-year period. NMFS Permits and Conservation Division actions are valid for five years, meaning icebreaker operations are expected to continue under MMPA rules and we assume that each of these rules will be similar to what will be authorized under the first MMPA rule issued for the vessel that will be delivered in 2023. If future rules are dissimilar from the action as described in this document, including the proposed PDCs to avoid and minimize potential effects of the action, or would not result in the same or fewer adverse effects to ESA-listed species and designated critical habitat as analyzed in this consultation, reinitiation of consultation would be required. Reinitiation would also be required if new species are listed under the ESA or additional critical habitat is designated that would be affected by the action. Similarly, if USCG operations with the new icebreakers change, particularly the locations and timing of icebreaking activities, such that there would not be the same or fewer effects to ESA-listed species and designated critical habitat as what was analyzed in this consultation, then reinitiation of consultation would be required.

Our analysis is also based on the current homeport location for the existing USCG polar icebreakers in Puget Sound, Seattle, Washington. The use of this homeport, in an area of existing military bases with over 300 military vessels, is not expected to require modifications to the homeport such as in-water construction or dredging. However, if the addition of 6 new icebreakers to the USCG fleet results in a future need to expand or modify the facilities in Seattle in a way that requires in-water construction or dredging, resulting in changes to the potential effects of the action such that there would not be the same or fewer effects to ESA-listed species and designated critical habitat in the Puget Sound area as what was analyzed in this consultation, then reinitiation of consultation may be required. Similarly, if a different homeport location is selected for some or all of the new icebreakers and this change would result in effects to ESA-listed species and designated critical habitat that are different from or greater than those analyzed in this consultation, then reinitiation of consultation would be required.

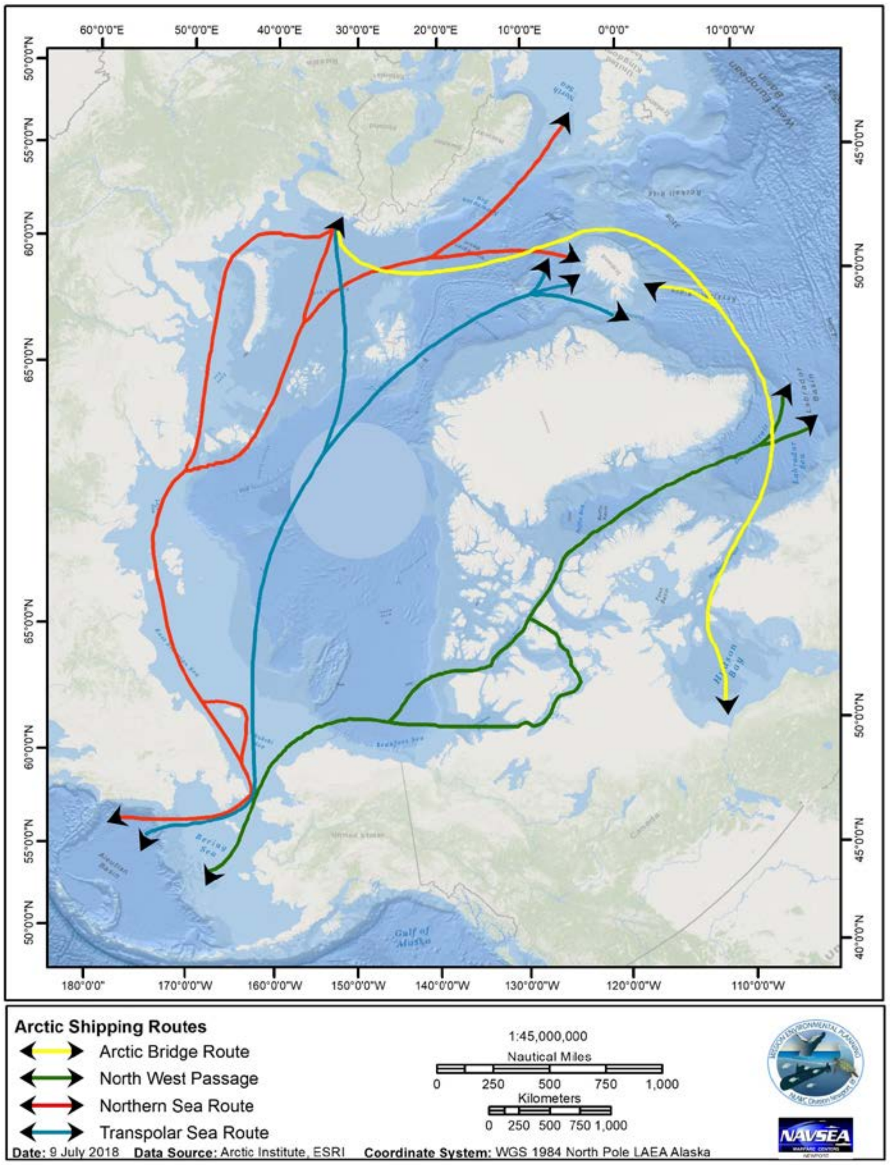


**Figure 14. Opening Arctic Shipping Routes as a Result of Decreasing Summer Sea Ice**

### 8.2.2 Definition of Take, Harm, and Harass

Section 3 of the ESA defines take as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. We categorize two forms of take, lethal and sublethal take. Lethal take is expected to result in immediate, imminent, or delayed but likely mortality. Sublethal take is when effects of the action are below the level expected to cause death, but are still expected to cause injury, harm, or harassment. Harm, as defined by regulation (50 CFR §222.102), includes acts that actually kill or injure wildlife and acts that may cause significant habitat modification or degradation that actually kill or injure fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding, or sheltering. Thus, for sublethal take we are concerned with harm that does not result in mortality but is still likely to injure an animal.

NMFS has not defined "harass" under the ESA by regulation. However, on October 21, 2016, NMFS issued interim guidance on the term "harass," defining it as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering." For this consultation, we rely on this definition of harass when assessing effects to all ESA-listed species except marine mammals.

For marine mammal species, prior to the issuance of the October 21, 2016 guidance, consultations that involved NMFS Permits and Conservation Division's authorization under the MMPA relied on the MMPA definition of harassment. Under the MMPA, harassment is defined as any act of pursuit, torment, or annoyance which:

- has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or
- has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B Harassment). Under NMFS MMPA regulation, Level B harassment does not include an act that has the potential to injure a marine mammal or marine mammal stock in the wild.

Our October 21, 2016 guidance states that our "interim ESA harass interpretation does not specifically equate to MMPA Level A or Level B harassment, but shares some similarities with both levels in the use of the terms 'injury/injure' and a focus on a disruption of behavior patterns. NMFS has not defined 'injure' for purposes of interpreting Level A and Level B harassment but in practice has applied a physical test for Level A harassment."

As discussed previously, the USCG used available data and models that provide estimates of MMPA Level B harassment in estimating the number of instances of harassment of marine mammals, and available data and models that provide estimates of MMPA Level A harassment. NMFS considers these estimates in our analysis of harassment of ESA-listed marine mammals (similar to Level B under the MMPA) and harm and/or injury under the ESA (similar to Level A under the MMPA), depending on the nature of the effects. MMPA Level B harassment as applied in this consultation may involve a wide range of behavioral responses on the part of ESA-listed marine mammals including but not limited to avoidance, changes in vocalizations or dive patterns, or disruption of feeding, migrating, or reproductive behaviors. However, as noted in other sections of this Opinion, NMFS has some concerns regarding the estimates of MMPA Level A and Level B harassment effects to marine mammals (see Appendix B) because of the discrepancy between the use of the NAEMO model and a step function with a 120 dB rms threshold to determine the potential extent of effects from icebreaking activities on ESA-listed marine mammals. An incidental take statement is included in this Opinion because take from these and other activities is reasonably certain to occur. While we analyze the potential effects of noise from icebreaking activities, a step-down consultation may be required under this programmatic consultation to evaluate whether the allowed incidental take of species for acoustic impacts from icebreaking activities included in this Opinion requires revision, including as part of MMPA authorization for new vessels.

## 8.3 Exposure, Response, and Risk Analyses

Section 8.1 described the activities and associated stressors in the action area we believe are not likely to adversely affect ESA-listed fin, humpback (Western North Pacific and Mexico DPSs), and bowhead whales, Arctic ringed and Beringia bearded seals, or proposed critical habitat for Arctic ringed seals. As discussed in Section 8.1, all of the activities in the Pacific Northwest, Antarctic operation area, and expected homeport of the new icebreakers are not likely to adversely affect ESA-listed species and their habitat. Some of the activities proposed in the Arctic operations area are also not likely to adversely affect ESA resources.

For the purpose of this analysis, the proposed activities in the Arctic operation area we expect to result in stressors with adverse effects to fin, humpback (Western North Pacific and Mexico DPSs), and bowhead whales, Arctic ringed seals, Beringia bearded seals, and proposed critical habitat for Arctic ringed seals are: icebreaking at full, half, and quarter power; ice condition testing as part of maneuverability testing, which requires icebreaking; vessel escort and tow, which includes icebreaking; law enforcement; SAR training; aircraft landing qualifications; vertical replenishment; and ice reconnaissance using helicopters. Stressors from these activities that may result in adverse effects include noise and visual disturbance during icebreaking, law enforcement, and aircraft operations for SAR training, landing qualifications, vertical replenishment, and ice reconnaissance, and physical damage to animals or their habitat during icebreaking.

We rely on NMFS stock assessment reports (https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock) to determine the densities of ESA-listed marine mammals in the Arctic operation area and estimate exposure to stressors from activities involving icebreaking, law enforcement, and aircraft operations as part of the action. We also use exposure estimates from NUWC modeling of the acoustic impacts of icebreaking on marine mammals from NAEMO (Appendix A) and using a step function with a threshold of 120 dB rms (Appendix B). These estimates were used throughout the remainder of our effects analysis.

### 8.3.1 Exposure to Stressors

In considering the exposures that could cause an effect to the populations described above, we consider where and when these exposures may occur, how long exposure may occur, the frequency and intensity, and the life stages, age, and sexes of animals that may be affected. We also consider the response of ESA-listed whales and seals to exposures and the potential reduction in fitness associated with these responses.

Western Arctic bowhead whales are widely distributed in the northern Bering Sea during the winter (November-April), generally associated with the marginal ice front. Most of these whales migrate north and east from April-May traveling through the Chukchi Sea into the Beaufort Sea. Bowheads range through the Beaufort Sea during most of the summer (June to September) independent of ice cover. From early September to mid-October, bowheads move west out of the Beaufort Sea and into the Chukchi Sea, returning to the Bering Sea through the Bering Strait by late-October and December (Rugh et al. 2003; Allen and Angliss 2014a). Some bowhead whales are found in the Chukchi and Bering Seas during the summer months, and are thought to be part of the expanding Western Arctic stock (Rugh et al. 2003). The Aerial Surveys of Arctic Marine Mammals (ASAMM) project conducted summare and fall (July 1 to October 29) field activities in 2018 targeting the northeastern and southcentral Chukchi and western Beaufort Seas (Clarke et al. 2019). The ASAMM project reported 430 sightings of 571 bowhead whales in the surveyed portions of the Chukchi and Beaufort Seas. These whales were seen in all months of the study period (Clarke et al. 2019). The bowhead spring migration from the Bering Sea north to the Chukchi Sea follows polynyas (a stretch of open water surrounded by ice) in the sea ice along the coast of Alaska, generally in the zone between the shorefast ice and mobile pack ice. During the fall migration south into the Bering Sea, bowheads appear to select shallow-shelf waters in low to moderate sea ice conditions, and slope waters in heavy ice conditions (Moore 2000). In the Bering Sea wintering grounds bowheads often use areas with 100 percent sea ice cover, even when polynyas are available (Allen and Angliss 2014a). Thus, all life stages of bowhead whales are likely to be susceptible to varying degrees of exposure depending on the time of year, type of activities, and location in terms of the sea where icebreaker-related activities occur in the Arctic operation area.

Fin whales occur in summer foraging areas in the Chukchi Sea, the Sea of Okhotsk, around the Aleutian Islands, and in the Gulf of Alaska. Surveys on the Bering Sea shelf in 1997, 1999, 2000, 2002, 2004, 2008, and 2010, and in coastal waters of the Aleutian Islands and the Alaska Peninsula from 2001 to 2003 provide information about the distribution and relative abundance of fin whales in these areas (Moore et al. 2000; Moore et al. 2002; Zerbini et al. 2006; Friday et al. 2012; Friday et al. 2013). Fin whales were usually the most common large whale sighted during Bering Sea shelf surveys with the highest abundances in an area of high productivity along the edge of the eastern Bering Sea continental shelf (Springer et al. 1996) and in the middle shelf. Abundance estimates were higher in cold years than in warm years, indicating a shift in distribution (Friday et al. 2012; Friday et al. 2013; Stabeno et al. 2012). The ASAMM 2018 surveys reported 77 sightings of 117 fin whales, including one calf, in the southcentral Chukchi Sea in July, September, and October (Clarke et al. 2019). We are not able to determine which life stages may be susceptible to varying degrees of exposure depending on the time of year, type of activities, and location in terms of the sea where icebreaker-related activities occur in the Arctic operation area, but it is clear that the species will be present during the expected peak of icebreaker activity in the area.  At this time, fin whales are present in the southernmost extent of the Arctic operation area where icebreaking activities currently do not occur. However, other stressors such as the use of aircraft and vessels for law enforcement activities and associated noise and visual disturbance are expected to occur within the current distribution of fin whales.

Humpback whales have been observed throughout much of the shelf waters (waters over the continental shelves) of the Bering Sea, but densities of humpbacks appear relatively low in the northern shelf area, with relatively few sightings north of St. Lawrence Island (Moore et al. 2002; Moore 2000; Friday et al. 2013). Humpback whales have also been observed during the summer in the Chukchi and Beaufort Seas (Allen and Angliss 2015). In August 2007, a mother-calf pair was sighted from a barge approximately 87 km (54.1 mi) east of Utqiagvik/Barrow in the Beaufort Sea (Hashagen et al. 2009). During vessel-based surveys in the Chukchi Sea, Hartin et al. (2013) reported four humpback whales in 2007, two in 2008, and one in 2010. Five humpback sightings (11 individuals) occurred during vessel-based surveys in 2009 and 2010 (Aerts et al. 2012), and a single humpback was observed several kilometers west of Utqiagvik/Barrow during the 2012 Chukchi Sea Environmental Studies Program vessel-based survey (Aerts et al. 2013). The Aerial Surveys of Arctic Marine Mammals (ASAMM) reported four humpback whale sightings near the coast between Icy Cape and Pt. Barrow in July and August of 2012, as well as 24 individual humpback whales on September 11, 2012, south and east of Pt. Hope (Clarke et al. 2013b). Humpback whales have been seen and heard with some regularity in recent years (2009-2012) in the southern Chukchi Sea. Sightings have occurred mostly in September, but effort in the southern Chukchi has not been consistent and it is possible that humpback whales are present earlier than September (Hashagen et al. 2009; Clarke et al. 2011; Crance et al. 2011). Additional sightings of four humpback whales occurred in 2009 south of Point Hope, while the survey vessel was transiting to Nome (Brueggeman 2010). More recently, Wade et al. (2016) revised modeling results estimating numbers of humpback whales based on phot-identification and determined that the population estimate for the Aleutian Islands and Bering Sea during the summer should be much higher while winter estimates didn’t change as much. Using the Multistrata model, the summer area estimate of humpback whales in the Aleutian Islands/Bering Sea is 14,693 (compared with the Chapman-Peterosn summer-summer model estimate that was used before of 2,348; (compared with the Chapman-Peterson summer-summer model estimate that was used before of 2,348; Wade et al. 2016). The 2018 ASAMM surveys reported 53 sightings of 79 humpback whales, including two calves, in the southcentral Chukchi Sea from July through September (Clarke et al. 2019). Based on the observations of humpback whales, adults and mother-calf pairs will be susceptible to varying degrees of exposure depending on the time of year, type of activities, and location in terms of the sea where icebreaker-related activities occur in the Arctic operation area. At this time, humpback whales (Western North Pacific and Mexico DPSs) are not expected to be present in areas where icebreaking currently occurs in the Arctic operation area. However, other stressors such as the use of aircraft and vessels for law enforcement activities and associated noise and visual disturbance are expected to occur in areas where adults and mother-calf pairs of humpback whales are present.

Arctic ringed seals in the Beaufort and Chukchi Seas spend most of their time in the water or in snowy lairs (90 percent August-November, 20 percent December-March) except during the spring molt when they spend an average of 55 percent of their time basking on ice (Kelly et al. 2010; Smith and Stirling 1975). Arctic ringed seals rest in their lairs from April to mid-May, particularly at night (Kelly et al. 2010). Ringed seals spend more time on ice once spring temperatures warm and lairs start becoming exposed, which occurs from approximately March to early June in the Bering and Chukchi Seas (Kelly et al. 2010). Basking while molting reaches a peak in the Arctic during June (Kelly et al. 2010; Born et al. 2002; Carlens et al. 2006; Harwood et al. 2007). Time out of water increases in June (Kelly et al. 2010). Given that peak activity for icebreakers is expected to be March to September based on current operations, all life stages of Arctic ringed seals will be susceptible to varying degrees of exposure depending on the month, type of activities, and location in relation to the location of lairs and ice.

The region that includes the Bering and Chukchi Seas is the largest area of continuous habitat for bearded seals, possibly due to the extent of favorable foraging habitat for the animals throughout the area (Cameron et al. 2010). In the Bering Sea where the Beringia bearded seal is present, early springtime sea ice habitat is used for whelping, and for nursing, mating, and some molting. During the breeding season, in May to June, bearded seals in the Bering Sea are near the ice front usually northward in heavier ice pack. As the ice retreats in the spring, most adults in the Bering Sea are thought to move north through the Bering Strait to spend summer and early fall at the southern edge of the Chukchi and Beaufort Sea pack ice and the margin of multi-year ice (Cameron et al. 2010). Juveniles often remain near the coasts of the Bering and Chukchi Seas for the summer and early fall instead of moving with the ice edge and are found in bays, brackish water estuaries, river mouths, and even traveling up rivers (Cameron et al. 2010). During the 2019 ASAMM survey in portions of the Chukchi and Beaufort Seas, 86 sightings of 97 bearded seals were reported in July through October, as well as a large number of sightings of pinnipeds that could not be identified to species (Clarke et al. 2019). Thirty five bearded seals were observed in the western Beaufort Sea and 61 in the northeastern Chukchi Sea, and an additional seal was see in the southcentral Chukchi Sea. More than half the seals were observed in July when there was still sea ice in the survey area with 22 of the observed seals hauled out on the ice (Clarke et al. 2019). Thus, icebreaker activity will overlap with the presence of adults and pups each year and with juvenile Beringia bearded seals depending on their movements.

Information on species-specific distribution and abundance in the Arctic operation area where activities involving icebreaking, law enforcement, SAR training, and other helicopter operations is necessary to calculate the number of animals potentially affected by these activities. This information is often expressed as the number of animals per square kilometer ($km^2$; density) of each species that may be present in a specific area and time of year. Density estimates for the Arctic for certain species are scarce but we relied on field-based density estimates from waters of Alaska, including the Bering, Chukchi, and Beaufort Seas, published literature from aerial and vessel surveys for marine mammals under MMPA research permits, and modeling work incorporating published data (Table 8). For publications that provided the $km^2$ of transects surveyed and the numbers of individual animals observed, we calculated density estimates. Otherwise, the density estimates in the table are those calculated by the researchers and included in the publication.

Two-dimensional marine mammal density estimates (animals/$km^2$) are based on the best available information but there are a number of caveats associated with these estimates that could affect their accuracy:

- They are often calculations using visual sighting data collected during one season rather than throughout the year. However, in the case of icebreaker-related activities considered in this consultation, the time of year when data were collected and from which densities were estimated overlap with the timing of the proposed activities based on current icebreaker operations.
- The survey areas do not coincide spatially with the entire Arctic operation area. Estimated densities from the survey areas are assumed to apply to the entire operation area.
- The densities used for purposes of estimating harassment and injury do not take into account the patchy distributions of marine mammals in an ecosystem, at least on the moderate to fine scales over which they are known to occur. Instead, animals are considered evenly distributed throughout the assessed area and seasonal movement patterns are not taken into account. A uniform density of animals year-round is also assumed.

**Table 8. Density Estimates for Fin, Humpback, and Bowhead Whales, and Ringed and Bearded Seals in the Arctic Operation Area**

| Marine Mammal | Calculated Densities (animals per $km^2$) | Citation |
|---|---|---|
| Fin Whale | 0.00048 (August only 2016 average) in Chukchi and Beaufort Seas; 0.0014 Bering Sea-Aleutian Islands | Clarke et al. (2017); Friday et al. (2013) |
| Humpback Whale | 0.00044 (August-September only 2016 average) in Chukchi and Beaufort Seas; 0.0016 for Western North Pacific DPS in Bering Sea-Aleutian Islands | Clarke et al. (2017); Highest density of any block from Zerbini et al. (2006) of 0.02 in block 12 and prorated stocks according to Wade et al. (2016) with 6 percent Western North Pacific in Bering Sea-Aleutian Islands |
| Bowhead Whale | 0.012 (2016 average) in Chukchi and Beaufort Seas; 0.017 Bering Sea-Aleutian Islands and 2.27 Chukchi-Beaufort Seas | Clarke et al. (2017); ASAMM 2008-2014 survey data of highest pooled monthly estimate for August or September 35-50 m depth zone |
| Ringed Seal | 1.765 (average from May 1999 and 2000) in Chukchi Sea; 0.011-0.091 (range of | Bengtson et al. (2005); Aerts et al. (2013); Conn et al. (2014) |

| | | |
|---|---|---|
| | averages 2008-2010) in Chukchi Sea; 0.3492 in Bering Sea-Aleutian Islands | |
| Bearded Seal | 0.175 (average from May 1999 and 2000) in Chukchi Sea; 0.003-0.055 (range of averages 2008-2010) in Chukchi Sea; 0.00024 (July-September only 2016 average) in Chukchi Sea; 0.3935 in Bering Sea-Aleutian Islands | Bengtson et al. (2005);Aerts et al. (2013); Clarke et al. (2017); Conn et al. (2014) |

*Icebreaking*

Icebreaking can occur under full, half, or quarter power. The USCG estimates that icebreaking at full power will occur 5 times per year over a 16-hour period with one hour of ramming and four hours off for a total of 20 hours of icebreaking; at half power 5 times per year for up to 16 hours each time with one hour icebreaking and four hours off for a total of 20 hours; and at quarter power 11 times per year for up to 16 hours each time again with one hour on and four hours off for a total of 44 hours. This means that, during an Arctic patrol, an average of 11 days of icebreaking could occur anywhere ice is present and there is a need to break ice for navigation within the Arctic operation area. Typically, the ship is driven up on top of the ice until the weight of the ship breaks the ice. The edge may also need to be scarfed (lip of ice shaved down with ship's hull) of the initial channel to widen it. Icebreaking in the Arctic is expected to occur from spring to fall, but the timing could change with changes in ice extent due to climate change. The noise generated by icebreaking operations is expected to have a frequency range of 0.025-12.8 kHz and 164-189 dB re 1 microPa @ 1 m rms (USCG 2019).

Ice condition testing for the icebreaker would consist of a training test for a channel departure so crew can train how to exit an area once the icebreaker breaks through, and a star maneuver to create a wider channel by moving forward and backward in a star-shaped pattern to break out of the ice. This testing would be done every 10 years and the icebreaker would take approximately two days to move into the ice (meaning icebreaking would be done over 2 days) and testing would then last for up to six hours.

Vessel escorts occur in ice and the icebreaker creates a channel for the vessel to follow behind at speeds of four to five knots. Based on the average number of escorts by other USCG assets in the Arctic operation area, a non-emergency vessel escort requiring the use of an icebreaker may occur once per year and last up to 24 hours, though an additional 48 hours of escorts may also be conducted per year depending on need. An icebreaker may also perform a convoy escort (escorting multiple vessels) in the Arctic operation area.

In terms of exposure of fin, humpback (Western North Pacific and Mexico DPSs), and bowhead whales, and Arctic ringed and Beringia bearded seals, as discussed previously, NMFS and the USCG (with assistance from the NUWC) are working on determining the best method for calculating the number of animals that may be affected by noise from future icebreaking operations. NMFS is concerned that the use of the NAEMO model underestimates the potential effects of exposure to icebreaking noise and has suggested using a threshold of 120 dB rms, but this yields very different estimates of the number of animals that will be exposed to icebreaking noise (see Table B.2 in Appendix B versus Table 7 in Appendix A). For example, the number of bearded seals exposed to icebreaking noise increases from 42 to 273 at full and half power and from 41 to 275 at quarter power using NAEMO versus a 120 dB step function model. The number of bowhead whales increases from 1 to 13 and 1 to 10, respectively; and the number of ringed seals increases from 764 to 4,802 and from 810 to 5,366, respectively (Table B.2, Appendix B). Additionally, the USCG did not include exposure estimates for fin whale and humpback whale Western North Pacific and Mexico DPSs or for concentrations of prey species used by ESA-listed marine mammals that could be adversely affected by the noise of icebreaking. This is due to the current distribution of fin and humpback whales, which is not likely to overlap with icebreaking activities at this time and because NAEMO does not model for prey species. The step-down consultation process for the MMPA authorizations for the new icebreakers will be used to determine at what levels take will occur from icebreaking activities and to ensure adverse effects are avoided and minimized as needed, including if fin and humpback whale distribution change in the future such that the animals will overlap with icebreaking activities.

In addition to exposure to noise from icebreaking activities, Arctic ringed seals have the potential to suffer injury, mortality, or significant behavioral effects due to the physical effects of icebreaking because of their use of sea ice to construct subnivean lairs for resting and pupping, and to bask and molt. Ringed seal pups have thin fur and require more time than other ice seal pups in subnivean lairs before beginning to spend longer periods in the water. MMPA permits for work involving disturbance of sea ice typically require that all ice activities begin no later than March 1 of each year to reduce potential disturbance to ringed seal birth lairs or dens because once seals have laired, they cannot move away without risk to the pups. Icebreaking by the USCG icebreakers will occur throughout the spring and summer months, meaning impacts to birth lairs, pups, and nursing mothers are likely.

Information from projects to construct ice roads provides data on potential impacts of the physical icebreaking and associated habitat disturbance to Arctic ringed seals. While ice road construction has not occurred in the same area as where icebreaking by the new icebreakers is anticipated, we use the information regarding physical impacts to habitat as the best scientific information available to assist us in evaluating the potential physical impacts of icebreaking activities on Arctic ringed seals and their habitat. Additionally, while ice road construction associated with oil and gas development typically occurs in the Beaufort Sea area in nearshore waters, the density of ringed seals based on surveys is similar to that of the Arctic operation areas where icebreaking by icebreakers will occur. Ringed seal density is estimated as 0.554 seals per $km^2$ in the winter and 0.61 seals per $km^2$ in the spring (calculated based on data in Kelly et al. 1986). Ringed seals that have summered in the Beaufort Sea are though to move west and south with the advancing ice pack with many seals dispersing throughout the Chuckchi and Bering

Seas where they remain throughout the winter and some staying in the Beaufort Sea (Frost 1985; Muto et al. 2018).

A total of 21 ringed seal structures were found along a proposed ice road, and 22 within the core survey area and 1 km monitoring zone for the creation of an ice island for oil exploration during an April 2000 survey (Williams et al. 2001). Of the structures found, 17 were breathing holes, 20 were lairs none of which were determined to be birthing lairs, and 6 were unidentified (Williams et al. 2001). Estimates of the number of ringed seal structures from monitoring associated with an oil exploration project found between 0.46 structures per $km^2$ and 0.62 structures per $km^2$ (Richardson and Williams 2004). The MMPA authorization for this project did not allow mortality of ringed seals as a result of the project, including ice road construction. A more recent MMPA permit application by Hilcorp Alaska, LLC to develop the Liberty Oil Field reservoir on the Outer Continental Shelf, Foggy Island Bay, Beaufort Sea, Alaska (83 FR 21276; https://www.fisheries.noaa.gov/action/incidental-take-authorization-hilcorp-alaska-construction-and-operation-liberty-drilling-and), requested authorization for two ringed seal mortalities over five years beginning in 2019 because of the higher level of activity and greater number of ice roads proposed (total constructed area of 10.8 $km^2$ assuming a road width of 200 ft) when compared to previous MMPA permits (none of which resulted in seal mortalities). This MMPA rule also allowed for eight lethal takes over the following 20 years. In 2019, Hilcorp/Eni requested authorization for 125 total ringed seal takes in the form of MMPA Level B harassment and 150 total takes in the form of mortality associated with ice road construction over a five-year period with a total constructed area of approximately 29 km between Hilcorp Northstar and Eni Spy Island and Oooguruk. NMFS proposed MMPA authorization would allow for three serious injuries/mortalities of ringed seals each for the Eni Spy Island and Eni Oooguruk sites and six serious injuries/mortalities for the Hilcorp Northstar site because it has almost twice as many ice road/ice trail kilometers as the Eni sites (https://www.federalregister.gov/documents/2020/01/17/2020-00393/takes-of-marine-mammals-incidental-to-specified-activities-taking-marine-mammals-incidental-to-ice).

An icebreaker traveling at 6 knots (quarter power icebreaking) for 11 days (the expected total days for each icebreaking patrol) would impact approximately 11.75 $km^2$ of sea ice[1]. An icebreaker traveling at 3 knots (full to half power icebreaking) for 10 days (the expected total days each icebreaking patrol with approximately 5 days at half power and 5 at full power), would impact approximately 4.75 $km^2$ of sea ice. There would also be impacts associated with vessel escort that could impact an additional 4.25 $km^2$ (assuming 72 additional hours of vessel

[1] Area of impact is calculated by determining the distance using speed in knots (nm per hour) times total travel time (in minutes) divided by 60 times 1.15 (to convert to statute miles) times 0.015 (assuming that the icebreaker cuts a channel approximately the width of the icebreaker, estimated at 0.015 mi or 80 ft) times 2.59 (to convert $mi^2$ to $km^2$). The result is then divided by the number of hours over which the icebreaker is expected to engage in icebreaking activity. The calculation assumes one hour of icebreaking and three hours off rather than constant ramming of ice over each icebreaking period. The calculation also assumes the icebreaker will travel in a straight line.

operation of icebreaking at quarter power). Because vessel transit during full and half power icebreaking is slower, travel distance is less. We use quarter power travel time (6 knots) as the worst case estimate because vessels are expected to travel further and therefore cause more impacts. Ice condition testing could impact an additional 2 $km^2$ (including the 2 days of transiting assuming these are 4 hours of icebreaking each day at quarter power over each 16-hour period). However, we do not include this in the impact estimates because it will occur only once every 10 years. Therefore, a total of 22.75 $km^2$ of sea ice could be impacted annually by the icebreaking activities that will be part of the action. It is important to note that these calculations assume the icebreaker will be traveling in a straight line, which is unlikely but was used to calculate the potential maximum amount of sea ice impacted by icebreaking activities annually.

If we use the latest density estimates for ringed seals in the Chukchi Sea of 0.011 to 0.091 animals/$km^2$ and in the Bering Sea of 0.3492 animals/$km^2$ (Table 8) and the total area of potential impacts from icebreaking as 22.75 $km^2$ of sea ice, then zero to two Arctic ringed seals in the Chukchi Sea, up to 8 Arctic ringed seals in the Bering Sea, or a combination of animals from each area could be injured or killed by icebreaking activity in the Arctic operation area. These estimates are in keeping with survey results reporting the number of ringed seal structures encountered in sea ice (Williams et al. 2001) and the latest proposed MMPA authorization of ringed seal take associated with the Hilcorp/Eni ice road construction in the coastal Beaufort Sea, Alaska, North Slope. Rather than annual mortality, we follow the same methodology as used in the ice seal MMPA authorizations and rules and estimate that these numbers represent the take of ringed seals over a five-year period because the ice preferred by ringed seals for building lairs is typically not of the type and location where icebreaking activities will occur, though this may change over time due to the effects of climate change that may lead to seals using less favorable sea ice habitat. In addition, variables including water depth, location relative to the fast ice edge, and ice deformation result in substantial and consistent effects on the distribution and abundance of seals (Frost et al. 2002).

Because the Arctic operation area encompasses the entire area of the proposed Arctic ringed seal critical habitat (approximately 350,000 $mi^2$) and the essential features of this habitat include sea ice habitat suitable for the formation and maintenance of subnivean birth lairs and sea ice habitat suitable as a platform for basking and molting, we believe any portion of the proposed critical habitat comprised of sea ice could be exposed to icebreaking activities associated with maintaining shipping lanes open, escorting one or more vessels, and conducting ice condition testing to test the maneuverability of the icebreaker. However, in a given year, the actual area of critical habitat exposed would be restricted to the specific areas where icebreaking occurs for the sea ice component of critical habitat and the zone to which acoustic impacts extend for the prey component of critical habitat. Based on the calculations of potential area impacted by icebreaking activities each year, a total of 22.75 $km^2$ of sea ice that is part of the proposed critical habitat for Arctic ringed seals could be impacted annually by icebreaking activities.

*Law Enforcement, SAR Training, and Other Helicopter Operations*

Icebreaker support of law enforcement activities is considered part of the action (e.g., vessel or helicopter activities), including associated USCG law enforcement training conducted from the vessels. There will be approximately 20 days of law enforcement activities during transit of icebreakers per year using up to two over-the-horizon boats deployed from the icebreaker to board fishing vessels and a helicopter to perform reconnaissance. Over-the-horizon boats would travel less than a mile from the icebreaker at roughly 30 knots. Boarding operations take a maximum of 12 hours. Law enforcement would occur in the Bering Sea and in the open ocean of the Arctic operation area.

During icebreaker patrols, the USCG would train for an actual SAR mission by dispatching helicopters, usually one at a time, to locate a vessel in distress and report its status and then dispatch a rescue vessel. Support boats simulating rescue vessels could travel at speeds up to 30 knots. The USCG would also train in how to transport people to safety and in damage control (e.g., plugging holes, patching pipes, or delivering supplies to aid in repair or control damage incurred by a vessel in distress). SAR training is expected to occur once per year with damage control training activities on the icebreaker happening over four hours and helicopter use lasting 12 hours.

In an analysis of the probability of lethal mortality of large whales at a given speed, results of a study using a logistic regression model showed that the greatest rate of change in the probability of a lethal injury to a large whale, as a function of vessel speed, occurs between vessel speeds of 8.6 and 15 knots (Vanderlaan and Taggart 2007b). Across this speed range, they found that the chances of a lethal injury decline from approximately 80 percent at 15 knots to approximately 20 percent at 8.6 knots. Notably, it is only at speeds below 11.8 knots that the chances of lethal injury drop below 50 percent and above 15 knots the chances asymptotically increase toward 100 percent. Neilson et al. (2012) summarize 108 reported whale-vessel collisions in Alaska from 1987–2011. In reports where vessel speed at the time of collision was known, 49 percent were travelling at or faster than 12 knots, 31 percent were traveling slower than 12 knots, and 20 percent were anchored or drifting vessels. The collisions with moving vessels were those likely to result in injury or mortality, particularly for larger vessels (greater than 260 ft in length; (Neilson et al. 2012).

Between 2012 and 2016, two Northeast Pacific fin whales were fatally struck by vessels, resulting in a mean annual mortality rate from ship strikes of 0.4 fin whales (Muto et al. 2018) in Alaska. Vessel collisions with humpback whales remain a significant management concern, given the increasing abundance of humpback whales foraging in Alaska, as well as the growing presence of marine traffic in Alaska's coastal waters. Neilson et al. (2012) reviewed 108 whale-vessel collisions in Alaska from 1978-2011 and found that 86 percent involved humpback whales. Collision hotspots occurred in Southeast Alaska in popular whale-watching locations.

The data from Neilson et al. (2012) did not include any strandings of bowhead whales as a result of vessel collisions.

Seals that closely approach larger vessels also have some potential to be drawn into bow-thrusters or ducted propellers (BOEM 2011). In recent years gray and harbor seal carcasses have been found on beaches in eastern North America and Europe with injuries indicating the seals may have been drawn through ducted propellers (BOEM 2011). To date, no similar incidents have been documented in Alaska (BOEM 2011) and the current design of the icebreakers does not include a ducted propeller. Sternfeld (2004) documented a single spotted seal stranding in Bristol Bay, Alaska, that may have resulted from a propeller strike. There have been no incidents of ship strike with bearded seals or ringed seals documented in Alaska (BOEM 2011).

Landing qualifications would involve approximately 15 helicopter takeoffs and landings from a icebreaker's flight deck over the course of 4 hours with 75 percent of these done during daylight hours and 25 percent at night. Landing qualifications will be done each month a vessel is on patrol.

Helicopters will conduct reconnaissance flights to detect open water leads in the ice where an icebreaker can more easily transit and to conduct reconnaissance flights in support of law enforcement activities. The primary aircraft to be used for ice reconnaissance is the MH-60 Jayhawk helicopter; however, the USCG may use UASs for ice and law enforcement reconnaissance, which were discussed in Section 8.1. Flight altitudes could range from 400 to 1,500 ft (122 to 457 m). Ice reconnaissance would occur over two hours and would be conducted twice per patrol in the Arctic operation area. Law enforcement reconnaissance is likely to require altitudes below 1,000 ft in order for helicopters to spot the object of interest. Helicopters also fly low during vertical replenishment because of the payload being carried under the aircraft. Altitudes of 500 to 1,000 ft are common during vertical replenishment, though every attempt is made to fly a route that avoids areas where marine mammals are known to concentrate.

In a comparison of seal reactions to the use of fixed-wing aircraft and helicopters, Born et al. (1999) found that 6 percent of seals escaped in response to the presence of fixed-wing aircraft as opposed to 49 percent when helicopters were used when aircraft flew at an altitude of approximately 150 m. Born et al. (1999) concluded that small fixed-wing aircraft needed to be at least 500 m from seals in order to reduce the risk of scaring the animals into the water, helicopters need to be further away, and no aircraft should be directly overhead. During the 2018 ASAMM surveys, four percent of the bearded seals hauled out on the ice in July responded to the survey aircraft by diving into the water (Clarke et al. 2019). In addition, another 111 unidentified pinnipeds, likely including ringed and bearded seals, or three percent, responded to the survey aircraft. Of these, most pinnipeds that responded were swimming, milling or resting in the water and responded by diving, but one group of 55 individuals and other smaller groups of animals flushed from haulouts on ice or land into the water (Clarke et al. 2019).

Animals could be affected by aircraft and support vessel operation associated with SAR training, landing qualifications, and ice reconnaissance. Law enforcement activities will only affect animals in the Bering Sea and open waters of the Arctic operation area as these activities rely on ice-free waters for support vessels to operate. In terms of exposure, in the Chukchi and Beaufort Seas, fin and humpback whales are expected to be affected only during August/September when these whales are most likely to be present in this part of the operation area. In the Bering Sea, these whales could be encountered throughout the expected icebreaker operation period from March to September. Similarly, bowhead whales, and ringed and bearded seals have different estimated densities (Table 8). The size of the Arctic operation area was not provided by the USCG but is extremely large and the use of support vessels and aircraft during the activities discussed in this section will not be concentrated in a particular area or areas. Therefore, because we have no way to estimate the potential number of animals that will be exposed to stressors based on area of operation, we use estimates from previous MMPA authorized research activities and density estimates of different species to determine the potential exposure of fin, humpback (Western North Pacific and Mexico DPS), and bowhead whales, Arctic ringed seals, and Beringia bearded seals. We use the lower numbers of allowed harassment of marine mammals from these permits because, while the research was targeting marine mammals, the USCG activities are not; therefore, less harassment of marine mammals associated with USCG activities is expected.

MMPA permits for ice seal research allowed for 5,000 ringed and bearded seals of each species to be disturbed by the use of vessels and aircraft to conduct surveys over 5 years (i.e., 1,000 each year of each species) and to disturb 500 fin and humpback whales due to the use of vessel and aerial survey techniques over 5 years (i.e., 100 each year of each species).

Thus, if we use numbers similar to those for research permits, each year up to 100 fin and humpback whales could be exposed to stressors from law enforcement, SAR training, landing qualifications, and ice reconnaissance in the Bering Sea, and 34 fin and 27 humpback whales in the Chukchi-Beaufort Seas (based on the difference in densities for each area for each species). Some of the humpbacks are expected to be mother-calf pairs based on the results of surveys in the Arctic. If we use numbers similar to those for research permits, up to 1,000 Arctic ringed and 1,000 Beringia bearded seals of various life stages could be exposed to stressors each year with the likelihood of exposure depending on where the activity occurs in relation to sea ice and the month of the year.

Up to 2,500 bowhead whales (using the highest number of observed animals in a given survey year and rounding up) of various life stages (neonate, juvenile, adult) could be exposed to stressors from these activites throughout the area each year with more likelihood of exposure in areas with ice each year.

In terms of the proposed critical habitat for Arctic ringed seals, exposure of prey to noise could result in disturbance of prey that is part of the essential features of the proposed critical habitat due to the operation of support vessels and aircraft during the law enforcement, training, and reconnaissance activities discussed in this section. This exposure could occur anywhere in the proposed critical habitat area where primary prey resources such as Arctic cod, saffron cod, shrimp, and amphipods co-occur with the stressor or stressors in a given year.

### 8.3.2 Response to Stressors

Arctic ringed seals are expected to attempt to flee the physical effects of icebreaking on their habitat. Escape responses could lead to injuries to seals including contusions, lacerations, abrasions, hematomas, concussions, and fractures if animals panic or are trapped in partially collapsed lairs, similar to the effects of attempting to escape during capture and release activities associated with research. Such injuries would reduce seal fitness. Twenty-one percent of observed ringed seals were found to respond behaviorally to simply the passage of an icebreaker vessel (not a vessel engaged in active icebreaking, just a transiting vessel doing scientific observations) with the majority of responses being looking and rapid dive/splash (Lomac-Macnair et al. 2019). Responses were more frequent when vessels were within 600 m of the animals, meaning that ringed seals in the areas where icebreaking is taking place are very likely to exhibit behavioral responses such as rapidly entering the water. There may also be an increased predation risk to seals, particularly pups, from being flushed into the water. Seals will also suffer stress as a result of disturbance from icebreaking. Chronic stress can impair the functionality of the immune and reproductive systems. Acute stress may result in hypothermia. As icebreaking will take place for multiple days in an area, ringed seals are expected to experience stress over multiple days associated with physical disturbance. Stress responses will decrease the fitness of these animals due to chronic or acute stress responses, which also increases the potential for injury or mortality from predation or due to the weakened physical condition of affected individuals.

The physical impacts to proposed ringed seal critical habitat, particularly sea ice used for lairs and basking and molting, will require seals to relocate and potentially to construct new structures if their lairs or other structures such as breathing holes are lost to icebreaking. While habitat impacts are expected to be limited each year, the effects will not be to the habitat area only, as seals are unlikely to stay in the area where the icebreaker is present due to visual and auditory disturbance. Therefore, a larger habitat area than simply the 22.75 $km^2$ of ice broken up by the icebreaker may be temporarily abandoned byseals in a given year where icebreaking activities are on-going. While seals are likely to reestablish their use of unbroken or reformed ice for haulouts once icebreaking activity has concluded in the area, the need to relocate from an area where mothers have established lairs, even temporarily, will have adverse effects on this species.

Fin, humpback, and bowhead whales, and ringed and bearded seals in the area of icebreaking activities are also expected to demonstrate varying levels of response to the noise generated by icebreaking. These include changes in behavior from mild responses such as raising heads and tail slapping to stronger responses such as fleeing the area. There could also be temporary and permanent threshold shifts affecting the hearing of these animals, though modeling results provided by NUWC for this consultation concluded that only behavioral changes were likely as a result of icebreaking noise. Depending on the severity of the threshold shift and whether it is temporary or permanent, an animal's ability to find prey and flee from predators may be affected, resulting in adverse effects to the animal with fitness consequences. Noise from icebreaking is also likely to affect prey species, potentially leading to changes in abundance and distribution of prey and foraging resources for animals. Studies of Atlantic cod, for example, indicate that noise consisting of a linear sweep from 100-1000 Hz can induce a stress response the intensity of which depends on the dose (in this case degree of exposure to sound). Daily exposure to a similar intensity and frequency noise range during the spawning window resulted in a significant reduction in total egg production and fertilization leading to a reduction in embryos of over 50 percent (Sierra-Flores et al. 2015). If the cod species that are preferred prey items of ringed seals exhibit similar responses, there could be adverse impacts to ringed seal foraging. If these changes are short-term, effects are expected to be minor but if the effects lead to a decline in the animal's ability to forage during the summer months or, in the case of mothers, feed their young, there could be fitness consequences for the animals. Icebreaking noise will be analyzed further in a step-down consultation.

During SAR training, vertical replenishment, and ice and law enforcement reconnaissance, helicopters will often fly below the altitude at which Born et al. (1999) observed a strong response, particularly when helicopters were used. MMPA permits issued to researchers using fixed-wing aircraft to perform aerial surveys of ice seals in the Bering, Chukchi, and Beaufort Seas determined these surveys had the potential to harass up to 5,000 Beringia bearded seals and 5,000 Arctic ringed seals. Of these, based on the percentage from the study by Born et al. (1999), 2,450 animals of each species (49 percent) were expected to respond by escaping into the water if helicopters were used at an altitude of approximately 500 ft (150 m). The rest of the disturbed seals were expected to respond by lifting their heads, extending their foreflippers, or moving their bodies. The results of the MMPA-permitted ice seal research activities documented no changes in the behavior of bearded seals, fin or humpback whales during vessel and aerial surveys, but did document changes in the behavior of 98 ringed seals during survey activities involving vessels and aircraft. It is important to note that these surveys use fixed-wing aircraft and UASs, and do not use helicopters, largely because helicopters were found to result in too much disturbance of animals.

The responses of cetaceans to aircraft depend on the animals' behavioral state at the time of exposure (e.g., resting, socializing, foraging, traveling) as well as the altitude and lateral distance of the aircraft to the animals (Luksenburg and Parsons 2009). The underwater sound intensity from aircraft is less than produced by boats and visually, aircraft are more difficult for cetaceans to locate because they are not in the water and move rapidly (Richter et al. 2006). The Alaska Fisheries Science Center Marine Mammal Laboratory MMPA permit for research on cetaceans allowed for the harassment of animals for the collection of sloughed skin, remains of prey, and sampling of skin/blubber; vessel surveys; and aerial surveys over a 5-year period. For bowhead whales, 2,233 animals were harassed by aerial surveys based on the report of results and of these, only 178 exhibited behavioral reactions to approaches from aircraft in 2012. In 2013, 22 animals were observed with no response. In 2014, 109 animals were observed with none exhibiting a response. In 2015, only 16 animals were observed during aerial surveys and none exhibited reactions to aircraft. However, only fixed-wing aircraft were used in these surveys and were flown at altitudes above which animals are not expected to respond.

When aircraft fly below certain altitudes (about 500 m [1,640.4 ft]), cetaceans sometimes exhibit behavioral responses that might constitute a significant disruption of their normal behavioral patterns (Patenaude et al. 2002). Thus, aircraft flying at low altitude, at close lateral distances and above shallow water such as when helicopters are performing ice reconnaissance, elicit stronger responses than aircraft flying higher, at greater lateral distances, and over deep water (Patenaude et al. 2002; Smultea et al. 2008). Helicopter rotor downwash, which will cause disturbance at the water surface and send spray away from the area below the helicopter, may be part of the disturbance response for aircraft traveling close to the water surface. During SAR training, for example, helicopters may approach close enough to the water to cause downwash. The distance to the water, horizontal distance from the rotor hub, and speed of the helicopter influence the extent to which the water under the aircraft will be disturbed and subsequently the response of animals. About 14 percent of bowhead whales approached during aerial surveys exhibited short-term behavioral reactions (Patenaude et al. 2002). While all ESA-listed whale species exposed to aerial surveys may exhibit short-term behavioral reactions to the use of aircraft during surveys, data from MMPA research permits indicate only mild behavioral responses, if any, when fixed-wing aircraft are used. As noted previously, the USCG will be engaging in activities that differ from scientific research targeting marine mammals but will be using helicopters, that may elicit a stronger response than fixed-wing aircraft, particularly when operated at altitudes lower than 1,500 ft during certain activities.

In terms of responses to vessels, the Northwest Fisheries Science Center (NWFSC) has been conducting research on cetaceans for a number of years. This research includes following some animals to observe their behaviors and to collect samples of pieces of prey items, sloughed skin, and feces. On about 3 of 465 vessel approaches for prey sampling, a reaction by the animal was recorded. The reaction took the form of increases in surface active behaviors, changes in swimming speed or direction, and/or altered surface and dive durations. These behaviors were usually minor and short-lived, even when small vessel operations were conducted at distances less than 100 m from cetaceans. However, the vessels in this and other scientific surveys typically operate at speeds at or below 10 knots whereas the USCG support vessels used during law enforcement and SAR training activities will operate at speeds up to 30 knots.

On-ice ringed seals exhibited short-term escape reactions (temporarily entering the water) when a ship came within 0.25 to 0.5 km (Brueggeman et al. 1992). Less drastic responses to disturbances would be head lifting, extension of flippers, and movement of body. Seals that do react to vessel disturbance may swim away if they are in the water.

Fleeing into the water is the most dramatic response to disturbance on the part of hauled-out seals. Less disturbed seals may also display behaviors such as head up, foreflippers extended, or movement (alternating flippers, body shape) indicating a response to aircraft and/or vessels.

Juveniles and non-nursing adult seals spend at least 80 percent of their time in the water (Kelly et al. 1986) and so would be less likely to be affected by the use of aircraft, but may be more likely to respond to vessels. An animal may be harassed multiple times each year based on the unpredictability of where ringed and bearded seals haul out and the size of the Arctic operation area.

Bearded seal pups enter the water within hours after birth (Kovacs et al. 1996) and pups aged four to seven days spend over half their time in the water (Lydersen et al. 1994). Pups rest close to ice holes so they can escape into the water when disturbed. Thus, disturbance as a result of the use of aircraft and support vessels is likely to result in a temporary loss of resting and haul-out time for pups annually and the same individuals could be affected multiple times per year, although over the course of the year the individual would mature to be self-sufficient and then a different age class.

Nursing females and ringed seal pups spend more time in lairs than non-nursing adult seals. Like bearded seal pups, ringed seal pups spend 50 percent of their time in the water (Lydersen and Hammill 1993). In contrast to bearded seals, ringed seal pups have a prolonged nursing period and accumulate blubber at a slow rate (Smith and Stirling 1975). For insulation against the cold, ringed seal pups rely on their woolly coat, which provides excellent insulation in air but offers almost no protection when wet (Ray and Smith 1968), meaning prolonged or frequent water entry could result in unsustainable energy costs for pups (Born et al. 1999). On the other hand, given that pups spend up to 50 percent of their time in the water, infrequent disturbance by aircraft and support is unlikely to affect the pups, even if the same individuals are affected multiple times per year.

Nursing female ringed and bearded seals are more likely to be disturbed by aircraft and support vessels than other adults because nursing females spend more time out of the water with their pups. As for other age groups, the same individuals could be affected multiple times per year.

In summary, noise from activities involving icebreaking, including icebreaking at full, half, and quarter power; vessel escort; and ice condition testing (every 10 years) is likely to adversely affect fin, humpback (Western North Pacific and Mexico DPSs), and bowhead whales, Arctic ringed seals, and Beringia bearded seals. The number of animals of each species that will be affected and the extent of adverse effects will be determined in a step-down consultation as each new PCS becomes operational and/or as part of future MMPA authorization actions.

Up to 10 Arctic ringed seals could be injured, killed, or suffer significant disturbance from icebreaking activity every five years in the Arctic operation area. While this estimate is in keeping with survey results reporting the number of ringed seal structures encountered in sea ice within a small survey area (Williams et al. 2001), it is not possible to determine how many of these animals will be injured or killed versus the number that will exhibit significant behavioral effects. Due to the size of the vessel versus the size of the seals and the fact that death is likely to be due to animals being crushed in subnivean lairs, it may not be possible for the USCG to determine whether mortality of animals has occurred as a result of icebreaking. Pups are more likely to suffer significant health effects or mortality because ringed seal pups cannot remain wet for long periods of time without unsustainable energy costs. These are also the animals most likely to be present in subnivean lairs when icebreaking activities occur and may be slower to respond by fleeing. Adult females that are affected by icebreaking and the physical impacts to habitat are also likely to suffer fitness consequences associated with stress responses and also the potential need for animals to construct new lairs.

Based on our calculations of exposure in Section 8.3.1, operation of helicopters for SAR training, landing qualifications, and ice reconnaissance for up to 24 hours per year in the Arctic operation area; and of support vessels at speeds up to 30 knots for up to 240 hours per year in the Bering Sea and open water as part of law enforcement activity, and for up to 12 additional hours as part of SAR training in the Arctic operation area could impact 134 fin whales, 127 humpback whales, 2,500 bowhead whales, 1,000 ringed seals, and 1,000 bearded seals annually through disturbance of normal behavior as animals attempt to avoid the helicopter or vessel (if we use numbers like those allowed in MMPA research permits). However, below we discuss our rationale for reducing these numbers of animals that could be taken through harassment from helicopter noise and fleeing from fast-moving support vessels. We use the findings of studies on responses of marine mammals to helicopters and high speed vessels to estimate the actual numbers of animals that could be harassed. In addition, we also base our estimates of likely numbers of animals taken on the difference between research activities that are targeting marine mammal species versus the USCG operational objectives, the likely densities of animals in the operation area (see Table 8) from marine mammal surveys, and the PDCs that will be required for the USCG icebreaker operations in the action area, many of which are already part of the SOPs for use of these vessels.

Helicopters elicit a stronger response than fixed-wing aircraft in cetaceans and seals, particularly when they are flown below 500 m for cetaceans (Patenaude et al. 2002) and 150 m for seals (Born et al. 1999). Because helicopters used as part of SAR training, resupply, and ice reconnaissance in particular will fly at altitudes that are likely to be below these thresholds for several hours, fin, humpback, and bowhead whales, and ringed and bearded seals are expected to exhibit behavioral responses that might constitute a significant disruption of their normal behavioral patterns during these helicopter operations. Based on the work by Patenaude et al. (2002) and Born et al. (1999), we expect approximately 14 percent of whales (meaning approximately 19 of the 134 fin whales, 18 of the 127 humpback whales, and 350 of the 2,500 bowhead whales) and 49 percent of seals (meaning 490 ringed seals and 490 bearded seals) to exhibit strong behavioral responses with higher energetic costs such as abandoning feeding and swimming away rapidly.

The operation of vessels at high speeds could lead to collisions with whales in particular (because ringed and bearded seals are highly agile in the water), but Arctic survey boats carried on icebreakers are typically less than 40 ft in length, meaning they are also highly maneuverable and of the size that is typically the most commonly involved in high speed collisions with whales, although they are not as likely to result in significant injury asy vessels larger than 260 ft in length (Neilson et al. 2012). Thus, the risk of vessel strike is high for small vessels but the risk of mortality is reduced for smaller vessels in the case of whales. While a vessel collision, even one with a smaller vessel, could result in injury, vessels strikes are rare in the Arctic operation area and the USCG did not have a record of ship strikes associated with support vessel operation. In addition, the USCG has a lookout on vessels to search for navigation hazards, including marine mammals, in order to minimize the potential for vessel collisions. Therefore, we believe behavioral responses to noise and visual observations of support vessels at high speeds during law enforcement activities are likely and vessel collisions are not.

Because the hours support vessels will operate will be concentrated during the summer over several days, behavioral responses to noise and the vessels themselves on the part of marine mammals in the Arctic operation area are more likely because of the potential for the same animals to be disturbed several times over the course of a patrol. Information from vessel surveys conducted as part of research permits indicates that whales respond to vessels a very low percentage of the time (less than one percent of the time based on NWFSC data). While research vessels operate at slower speeds, they also often do close approaches to whales to collect samples, meaning whales may startle as they would when support vessels from icebreakers are operating at high speeds. Behavioral responses on the part of whales are expected to take the form of increases in surface active behaviors, changes in swimming speed or direction, and/or altered surface and dive durations. Similarly, ice seals are expected to flee into the water if startled or swim away and potentially haul out if in the water in the vicinity of a fast moving vessel. Unlike helicopters, we do not have information regarding the proportion of animals expected to demonstrate a measurable response to vessel movement. However, if we use information from research permits, it appears that approximately 1 percent of cetaceans exhibit clear behavioral responses to vessel approaches (3 out of 465 from multi-year survey efforts) and 3 percent of ringed seals (3 out of 98). Bearded seals were not reported as harassed by the use of aerial and vessel surveys except during targeted sampling efforts so we will assume the same percentage as for ringed seals to be conservative. This means that 1 fin whale, 1 humpback whale, 25 bowhead whales, 30 ringed seals, and 30 bearded seals are expected to exhibit strong behavioral responses each summer with higher energetic costs that will affect the fitness of these individuals.

The implications of the responses of fin whales, humpback whales (Western North Pacific and Mexico DPSs), and bowhead whales, Arctic ringed seals, and Beringia bearded seals, and the effects to proposed Arctic ringed seal critical habitat are discussed below in our risk and programmatic analyses.

### 8.3.3 Risk Analysis

As stated previously, we believe icebreaking noise is likely to result in behavioral responses and potential injury or mortality of fin, humpback, and bowhead whales, Arctic ringed seals, and Beringia bearded seals, as well as responses on the part of important prey species for these animals. However, the extent of these impacts in terms of the number of animals likely to suffer effects will be determined in a step-down consultation as part of the required MMPA authorization process for take of marine mammals associated with operation of each of the icebreakers as they come on line. This is due, in part, to the need to agree on a method for evaluating the acoustic impacts of icebreaking noise on marine mammals using a Working Group as proposed by the USCG that will include NMFS ESA Interagency Cooperation Division and Permits and Conservation Division.

The physical disturbance of ringed seal habitat is likely to reduce the fitness of individuals, most likely mothers and pups, including potentially causing mortality each year in areas where icebreaking occurs. Physical, visual, and acoustic disturbance of proposed critical habitat is also likely to contribute to this reduction in fitness of ringed seals.

The behavioral effects to fin whales, humpback whales, bowhead whales, Arctic ringed seals, and Beringia bearded seals as a result of strong responses to high speed operation of support vessels during law enforcement and SAR training activities and helicopter operations associated with SAR training, landing qualifications, and ice reconnaissance are likely to reduce the fitness of a proportion of individual animals that react strongly to the stressors created by these activities. For these individuals, strong behavioral responses will have energetic consequences that could reduce an animal's ability to grow and reproduce and have health consequences such as weight loss and greater susceptibility to disease and predation, particularly in the case of ice seals. Some of these animals, particularly those disturbed multiple times over a given summer and also depending on age class (with pups being more likely to suffer greater consequences than healthy adults) could die as a result of stress. As discussed in Section 8.3.1, all life stages of bowhead whales, Arctic ringed seals, and Beringia bearded seals; adult humpback whales and mother-calf pairs; and undetermined life stages of fin whales (life stage cannot be determined based on available data) could be affected. It is not possible to determine, with the exception of mother-calf pairs for whale species and mother-pup pairs for ice seal species, whether affected animals will be males or females.

The annual potential mortality or decrease in fitness includes ringed seals as a result of icebreaking (estimated as 10 animals every five years); a decrease in fitness of 19 fin whales, 18 humpback whales, 350 bowhead whales, 490 ringed seals, and 490 bearded seals due to responses to helicopter operations (based on percentages of animals demonstrating signs of disturbance from studies); and a decrease in fitness of 1 fin whale, 1 humpback whale, 25 bowhead whales, 30 ringed seals, and 30 bearded seals due to responses to fast-moving support vessels (based on percentages of animals demonstrating signs of disturbance from studies). The rest of the animals that may be incidentally harassed by support vessel and helicopter operations (114 fin whales, 108 humpback whales, 2,125 bowhead whales, 480 ringed seals, and 480 bearded seals) are not expected to exhibit a response to stressors or will exhibit only a mild, short-term response such as head-raising that will not result in fitness consequences. Therefore, the rest of this discussion focuses only on those animals expected to demonstrate fitness consequences as a result of the action (with the exception of icebreaking noise for reasons explained previously).

We use the NMFS 2017 and 2019 stock assessment report (Muto et al. 2018; Muto et al. 2019; https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock) for each species to evaluate the effects of mortalities and decreases in fitness as a result of the proposed activities over the expected 40-year icebreaker lifetime on fin whales, humpback whales (Western North Pacific and Mexico DPSs), bowhead whales, Arctic ringed seals, and Beringia bearded seals.

NMFS recognizes four stocks of fin whales of which the Northeast Pacific stock is the one found in Alaska waters. Based on whaling data, the historical range of fin whales extended into the southern Sea of Okhotsk and Chukchi Sea. They likely passed through the Bering Strait into the southwestern Chukchi Sea during August and September. Fin whale sightings have been increasing during surveys conducted in the U.S. portion of the northern Chukchi Sea in summer (Funk et al. 2010; Aerts et al. 2012; Clarke et al. 2013a) and calls were recorded from 2007 to 2010 in August and September in the northeastern Chuckchi Sea (Delarue et al. 2013). Results of surveys on the eastern Bering Sea shelf in 2002, 2008, and 2010 conducted in conjunction with surveys for walleye pollock provided provisional estimates of 419, 1,368, and 1,061 fin whales, respectively (Friday et al. 2013). Other surveys reported up to 171 sightings of fin whales in the Gulf of Alaska (Rone et al. 2017) and 276 in coastal waters of western Alaska and the eastern and central Aleutian Islands (Zerbini et al. 2006). The minimum abundance estimate for the Northeast Pacific stock of fin whales in Alaska waters is 2,554 whales, although this is likely an underestimate for the stock because it is based on surveys that covered only a small portion of the stock's purported range (Muto et al. 2018).

In terms of the potential impact of fitness consequences to 20 fin whales as a result of significant disturbance from high-speed operation of support vessels and the use of low-flying helicopters for specific activities in the Arctic operation area, we consider the population effects in the context of total annual mortality associated with human activities. The total estimated minimum annual level of human-caused mortality and serious injury to Northeast Pacific fin whales in 2012 to 2016 is 0.4 whales with half of these due to commercial fisheries in U.S. waters and half due to ship strikes. The 20 whales expected to suffer fitness consequences as a result of the action are not expected to die and so the action is not expected to contribute to an increase in total annual mortality. Therefore, we conclude the fitness effects to 20 fin whales annually as a result of the action, which may be the same animals rather than 20 separate animals each year and even over the course of the same year, will not have a measurable effect on the population and is not likely to reduce the population viability of fin whales.

The historic summer feeding range of humpback whales in the North Pacific encompassed coastal and inland waters around the Pacific Rim from Point Conceptrion, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk, and north of the Bering Strait (Nemoto 1957; Johnson and Wolman 1984). Humpback whales are still found throughout this historic range with sightings during summer months as far north as the Beaufort Sea (Hashagen et al. 2009). Humpback whales are increasingly seen north of the Bering Strait into the northeastern Chukchi Sea (Clarke et al. 2013a; Clarke et al. 2013b). Humpback whales were the most commonly recorded cetacean on hydrophones just north of the Bering Strait from September to early November during a study from 2009 to 2012 (Muto et al. 2018). Whales from the Western North Pacific and Mexico DPSs may overlap broadly and mix to a limited extent on summer feeding grounds from British Columbia up to the Bering Sea (Muto et al. 2018). During the 2004 to 2006 Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) project, abundance estimates of 6,000 to 14,000 individuals in the Bering Sea and Aleutian Islands and from 3,000 to 5,000 for the Gulf of Alaska were calculated (Calambokidis et al. 2008). The SPLASH abundance estimates are based on point estimates from fluke identification photographs in all known feeding areas from Russia to California and in all known wintering areas from Okinawa and the Philippines to the coast of Central America and Mexico during 2004 to 2006.

In terms of the potential impact of fitness consequences to 19 humpback whales (from either the Western North Pacific or Mexico DPS or both) as a result of significant disturbance from high-speed operation of support vessels and the use of low-flying helicopters for specific activities in the Arctic operation area, we consider the population effects in the context of total annual mortality associated with human activities. Only the total estimated annual level of human-caused mortality and serious injury for Western North Pacific humpback whales is included in the 2017 stock assessment report. This minimum estimate is 3.2 Western North Pacific humpback whales based on the period from 2011 to 2015. Of these, 0.8 is due to commercial fisheries in U.S. waters, 0.4 due to recreational fisheries, 0.6 due to unknown fisheries (commercial, recreational, or subsistence), 0.8 due to marine debris, and 0.6 due to other causes (ship strikes and entanglement in ground tackle of ships). This is considered a minimum estimate because there are no data from Japan, Russia, and international waters regarding fishery-related mortality and serious injury to this species from other human activities. The 19 whales expected to suffer fitness consequences as a result of the action are not expected to die and so the action is not expected to contribute to an increase in total annual mortality. Therefore, we conclude the fitness effects to 19 humpback whales annually as a result of the action, which may be the same animals rather than 19 separate animals each year and even over the course of the same year, will not have a measurable effect on the population and is not likely to reduce the population viability of humpback whales (or at a minimum that of the Western North Pacific DPS because the stock assessment did not include the Mexico DPS).

Four stocks of bowhead whales have been reconized worldwide by the IWC (IWC 2010). The only stock in U.S. waters is the Western Arctic stock, the majority of which migrates annually from wintering areas (December to March) in the northern Bering Sea, through the Chukchi Sea in the spring (April through May), to the eastern Beaufort Sea in the summer (June through early to mid-October) before returning again to the Bering Sea in the fall (September through

December) to overwinter (Braham et al. 1980; Moore and Reeves 1993; Quakenbush et al. 2010b; Citta et al. 2015). The minimum abundance estimate for the Western Arctic stock of bowhead whales is 16,100 whales (Muto et al. 2018).

In terms of the potential impact of fitness consequences to 375 bowhead whales as a result of significant disturbance from high-speed operation of support vessels and the use of low-flying helicopters for specific activities in the Arctic operation area, we consider the population effects in the context of total annual mortality associated with human activities. The total minimum estimated annual level of human-caused mortality and serious injury for bowhead whales is 43 bowhead whales based on the period from 2011 to 2015. Of these, 0.2 is due to commercial fisheries and 43 from subsistence takes by Natives of Alaska, Russia, and Canada. The 375 whales expected to suffer fitness consequences as a result of the action are not expected to die and so the action is not expected to contribute to an increase in total annual mortality. Therefore, we conclude the fitness effects to 375 bowhead whales annually as a result of the action, which may be the same animals rather than 375 separate animals each year and even over the course of the same year, will not have a measurable effect on the population and is not likely to reduce the population viability of bowhead whales.

For stock assessment purposes, NMFS considers the Beringia DPS bearded seals to be the Alaska stock of the bearded seal (Muto et al. 2017b). Bearded seal sounds have been recorded nearly year-round at multiple locations in the Bering, Chukchi, and Beaufort Seas with peaks in December to June and variation in calling behavior based on the presence of sea ice (MacIntyre et al. 2013; MacIntyre et al. 2015). As ice forms in fall and winter, most seals move south with the advancing ice edge through the Bering Strait into the Bering Sea (Frost et al. 2005; Frost et al. 2008; Cameron and Boveng 2007;2009) but this migration is less noticeable and predictable than the northward movements in late spring and early summer through the Bering Strait to the Chukchi Sea (Burns and Frost 1979; Burns 1981; Kelly 1988). Conn et al. (2014) used a limited sub-sample of 2012 aerial abundance survey data from the U.S. portion of the Bering Sea to calculate an abundance estimate of 299,174. Using this estimate, NMFS calculated a minimum population estimate of 273,676 bearded seals in the U.S. portion of the Bering Sea (Muto et al. 2018), excluding seals in the Chukchi and Beaufort Seas in U.S. waters because Conn et al. (2014) did not include data for these seals in their abundance estimate. Muto et al. (2018) used this minimum to calculate a potential biological removal rate of 8,210 seals, but a similar calculation cannot be made for the entire stock because an estimate of minimum population is not available.

In terms of the potential impact of fitness consequences to 520 Beringia bearded seals as a result of significant disturbance from high-speed operation of support vessels and the use of low-flying helicopters for specific activities in the Arctic operation area, we consider the population effects in the context of total annual mortality associated with human activities. For the period from 2010 to 2014, the estimated minimum mean annual mortality and serious injury rate incidental to U.S. commercial fisheries is 1.4 bearded seals, based on observer data only. For the period from

2009 to 2013, only 12 of 64 coastal communities practicing subsistence harvest were surveyed. Subsistence harvest reported from these communites was 353 in 2009 (4 communities reporting), 217 in 2010 (5 communities reporting), 752 in 2011 (10 communities reporting), 406 in 2012 (5 communities reporting), and 220 in 2013 (2 communities reporting). Due to the unusual number of marine mammals discovered with similar symptoms across a wide geographic area, NMFS and USFWS declared a Northern Pinniped UME on December 20, 2011 and disease surveillance from 2012 to 2015. The UME occurred from May 1, 2011 to December 31, 2016, involving primarily ice seals including ringed, bearded, ribbon (*Histriophoca fasciata*), and spotted seals (*Phoca largha*) in northern and western Alaska. The minimum estimate of the total number of impacted seals was 657 seals, which included 233 dead stranded seals, 179 subsistence hunted seals, and 245 live seals that stranded or were sampled during permitted health assessments studies. The investigation identified that clinical signs were likely due to an abnormality of the molt, but a definitive cause for the abnormal molt and the UME was not determined. It does not appear that the UME has continued but seals recovering from disease may suffer greater fitness consequences and have a longer recovery period than healthy individuals. The 520 bearded seals expected to suffer fitness consequences as a result of the action are not expected to die and so the action is not expected to contribute to an increase in total annual mortality. Therefore, we conclude the fitness effects to 520 bearded seals annually as a result of the action, which may be the same animals rather than 520 separate animals each year and even over the course of the same year, will not have a measurable effect on the population and is not likely to reduce the population viability of Beringia bearded seals.

NMFS considers the Alaska stock of ringed seals the portion of the Arctic subspecies that occurs in the EEZ of the Beaufort, Chukchi, and Bering Seas for stock assessment purposes. During the winter and early spring in Alaska waters, ringed seals are abundant in the northern Bering Sea, Norton and Kotzebue Sounds, and throughout the Chukchi and Beaufort Seas. Most ringed seals that winter in the Bering and Chukchi Seas are thought to migrate north as the seasonal ice melts and spend summers in the pack ice in the northern Chukchi and Beaufort Seas and nearshore ice remnants in the Beaufort Sea (Burns 1970; Frost 1985). Using survey estimates from Bengtson et al. (2005) and Frost et al. (2004) in the 1990s and 2000, Kelly et al. (2010) estimated the total population in the Alaska Chukchi and Beaufort Seas to be at least 300,000 ringed seals. This is likely an underestimate because the Beaufort Sea surveys were limited to within 40 kilometers from shore (Muto et al. 2017b). The minimum population estimate for the U.S. sector of the Bering Sea was calculated as 170,000 by Conn et al. (2012) using data from the same survey as for bearded seals (Muto et al. 2018). This does not include seals from the Chukchi or Beaufort Seas. Muto et al. (2018) used this minimum to calculate a potential biological removal rate of 5,100 seals, but a similar calculation cannot be made for the entire stock because an estimate of minimum population is not available.

In terms of the potential impact of fitness consequences to 520 Arctic ringed seals as a result of significant disturbance from high-speed operation of support vessels and the use of low-flying helicopters for specific activities in the Arctic operation area; and mortality, injury, or fitness consequences as a result of icebreaking activities, we consider the population effects in the context of total annual mortality associated with human activities. For the period from 2010 to 2014, the estimated average annual mortality and serious injury rate incidental to U.S. commercial fisheries is 3.9 ringed seals, based on observer and stranding data. For the period from 2009 to 2013, only 12 of 64 coastal communities practicing subsistence harvest were surveyed. Subsistence harvest reported from these communites was 1,122 in 2009 (4 communities reporting), 784 in 2010 (5 communities reporting), 1,286 in 2011 (10 communities reporting), 1,230 in 2012 (5 communities reporting, and 827 in 2013 (2 communities reporting). Ringed seals are also part of the Arctic ice seal UME described above. There was also a gunshot mortality reported in 2011 that was thought to be part of the subsistence harvest that was lost and a report of 1 mortality due to research activities in 2013. Population-level effects are not anticipated from the potential loss of or injury to 37 ringed seals and the non-lethal fitness consequences to 520 ringed seals as a result of the action. Therefore, we conclude the mortality or injury of up to 10 animals (over a five-year period) and the fitness effects to 520 ringed seals annually as a result of the action (that may be the same animals rather than 520 separate animals each year and even over the course of the same year) will not have a measurable effect on the population and is not likely to reduce the population viability of Arctic ringed seals. It is important to note that many, if not all of these animals, regularly experience harassment, as well as more minor responses to stressors, associated with research and other human activities in the Arctic operation area as described in the *Environmental Baseline* (Section 8) and the populations of all of these species appear to be, at a minimum, stable.

### 8.3.4 Summary of the Effects of the Action on Fin Whales, Western North Pacific and Mexico Humpback Whales, Bowhead Whales, Arctic Ringed Seals, Beringia Bearded Seals, and Proposed Critical Habitat for Ringed Seals

The implementation of the USCG PSC Program with up to six new icebreakers is expected to result in the take of Arctic subspecies ringed seals and the modification and loss of proposed Arctic ringed seal critical habitat due to physical impacts from icebreaking. The action is also expected to result in the take of fin whales, humpback whales (Western North Pacific and Mexico DPSs), bowhead whales, Arctic ringed seals, and Beringia bearded seals due to noise from icebreaking, activities involving the operation of helicopters at low altitudes, and the use of fast-moving support vessels during law enforcement and certain other activities, which could also result in non-lethal vessel strikes of whale species.

We estimate that the physical aspects of icebreaking activities will result in mortality, injury and/or harassment of 10 Arctic ringed ice seals (2 in Chukchi and 8 in Bering Sea) over a five-year period, and the modification or loss of 22.75 $km^2$ of proposed Arctic ringed seal critical habitat annually. This equates to 80 Arctic ringed seals, expected to be females and pups, and 910 $km^2$ of proposed critical habitat over the anticipated 40-year program life.

We estimate that the noise generated by the operation of helicopters at low altitudes will cause non-lethal effects to the following numbers of fin, humpback, bowhead, ringed, and bearded seals each year:

- 19 fin whales (life stage cannot be determined based on available data)
- 18 humpback whales (adults, possibly some mother-calf pairs)
- 350 bowhead whales (all life stages)
- 490 Arctic ringed seals (all life stages)
- 490 Beringia bearded seals (all life stages).

We estimate that the noise generated by the use of fast-moving support vessels during certain activities and the potential vessel strike of whales by these vessels will cause non-lethal effects to the following numbers of animals each year:

- 1 fin whale (life stage cannot be determined)
- 1 humpback whale (adult or calf)
- 25 bowhead whales (all life stages)
- 39 Arctic ringed seals (all life stages)
- 490 Beringia bearded seals (all life stages).

We have not estimated the numbers of whales and seals that will be affected by icebreaking noise, as explained previously, but anticipate there will be effects including injury and harassment from icebreaking noise that will be further analyzed in step-down consultations as the new icebreakers are under construction.

It is possible that the same animals would be affected each year by noise from icebreaking, helicopter operations, and operation of fast-moving support vessels.

# 9 CUMULATIVE EFFECTS

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 C.F.R. §402.02). Future Federal actions that are unrelated to the action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

For this consultation, cumulative effects include climate change, fishing, whaling and subsistence harvest, vessel traffic and tourism, water quality degradation, ocean noise, oil and gas activities, scientific research, military activities, and predation. There are active oil fields in the Beaufort Sea and oil exploration has taken place in the Chukchi Sea. However, due to changes in leases in these areas, the exact locations and amount of leasing for oil and gas activities in the foreseeable future in the action area cannot be determined. With the increase in sea ice loss, vessel traffic is likely to increase in the forseeable future to support oil and gas activities, shipping and transportation, recreational cruises and whale-watching, scientific research, and military activities. Hunting and fishing activities are expected to continue into the foreseeable future. We are not aware of any proposed or anticipated changes in hunting and fishing that would substantially change the impacts of these activities on fin, humpback, and bowhead whales, and Arctic ringed and Beringia bearded seals. Melting of sea ice and continued terrestrial and maritime development appear to be contributing to increases in transport of land-based pollutants to marine waters and discharges of pollutants to marine waters and this trend is expected to increase as climate change continues.

# 10 INTEGRATION AND SYNTHESIS

The *Integration and Synthesis* section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the action. In this section, we add the *Effects of the Action* (Section 8) to the *Environmental Baseline* (Section 7) and the *Cumulative Effects* (Section 9) to formulate the agency's biological opinion as to whether the action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the *Status of the Species and Critical Habitat* (Section 6.2).

Some ESA-listed species and designated critical habitat are located within the action area but are not expected to be affected by the action or the effects of the action on these resources were determined to be insignificant or extremely unlikely to occur. Some activities evaluated individually were determined to have insignificant effects or effects that are extremely unlikely to occur and thus to be not likely to adversely affect some ESA-listed species and designated critical habitat (Sections 6.1 and 8.1).

The following discussions separately summarize the probable risks the action poses to fin whales, humpback whales (Western North Pacific and Mexico DPSs), bowhead whales, Arctic ringed seals, Beringia bearded seals, and proposed critical habitat for ringed seals. These summaries integrate the exposure profiles presented previously with the results of our response analyses for each of the activities considered further in this Opinion, specifically helicopter operations associated with SAR training, ice and law enforcement reconnaissance, and vertical replenishment; high-speed support vessel operation for law enforcement and SAR training; and the physical effects of icebreaking. Up to 10 ringed seal mortalities (estimated over a five-year period) and non-lethal take of an additional 529 ringed seals, 980 bearded seals, 20 fin whales, 19 humpback whales, and 375 bowhead whales are anticipated annually as a result of these activities. Additionally, while noise of icebreaking was discussed briefly in this document, a step-down consultation will be required to fully consider the extent and effects of this activity on ESA-listed species and their habitat, particularly in the Arctic operation area, because additional lethal and non-lethal effects are anticipated as a result of icebreaking noise and the where and when the effects will occur will be better known.

## 10.1 Jeopardy Analysis

The jeopardy analysis relies upon the regulatory definition of “to jeopardize the continued existence of a listed species,” which is “to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 C.F.R. §402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

### 10.1.1 Cetaceans

Bowhead whales are present year-round in the Arctic operation area while fin and humpback (Western North Pacific and Mexico DPSs) whales are present during the summer months. While these species differ in morphology, physiology, behavior, and ecology, they are expected to be exposed to the same stressors from the small vessel speeds and helicopter operations associated with the activities specified above. In addition, as discussed in Section 8.3, we expect the responses of these three whale species to these stressors to be similar.

No reduction in the distributions of these three whale species is expected as a result of the proposed activities in the Arctic operation area.

In the 2017 Marine Mammal Stock Assessment Report, Muto et al. (2018) note that, while some authors estimate rates of increase of fin whales in Alaska (Zerbini et al. 2006 estimates an annual increase of 4.8 percent for 1987 to 2003 ; Friday et al. 2013 estimates a 14 percent annual rate of increase from 2002 to 2010), it is likely that some or all of the apparent increase in abundance of fin whales in Alaska waters is due to changes in distribution rather than population growth. Thus, increases in observed fin whale abundance may be due to distribution shifting and dispersal of new individuals into the area. Regardless, the population appears to be stable at a minimum. Similarly, the abundance estimate for Asia (which is the only one available for humpback whales from SPLASH) indicates an annual rate of increase of 6.7 percent from 1991 to 1993, though this is considered to be biased high. The Western Arctic stock of bowhead whales increased at a rate of 3.7 percent from 1978 to 2011 with abundance tripling from approximately 5,000 to 16,820 individuals (Givens et al. 2013; Givens et al. 2016).

While any life stages of bowhead whales, which are present year-round in the Arctic operation area, might be affected by non-lethal take in the form of harassment of 375 individuals, none of these animals will be targeted by the proposed activities. All take is anticipated to have short-term consequences with the exception of noise from icebreaking that may result in long-term injury and will be discussed further in a step-down consultation. The anticipated non-lethal take of 375 individuals in a given year, if of sexually mature males and/or females, could lead to a loss of reproduction at an individual level if, for example, harassment interrupted mating or led an animal to flee an area during mating season. However, this loss is not expected to last all season in a given year because the icebreaker will continue moving through the area and bowhead whales will also be moving.

For humpback whales, life stages that may be present are adults, juveniles, and mother-calf pairs. For fin whales, life stages that may be present cannot be determined based on available data but would include adults. These animals would be present mainly in August and September and are not expected to be engaged in reproductive activities while in the Arctic operation area. The anticipated non-lethal take of 20 fin and 19 humpback whales in a given year is not expected to lead to a loss of reproduction at an individual level.

The action will not affect the species' current geographic range or the range of humpback whale DPSs. Based on the population estimates for these whale species (although limited by limited data to allow detailed stock assessments), the non-lethal take of 375 bowhead whales, 20 fin whales, and 19 humpback whales is not expected to exceed 2, 0.78, and 0.13 to 0.3 percent of the total abundance of bowhead, fin, and humpback whales, respectively, in waters within the Arctic operation area on an annual basis. For this reason, we do not expect the non-lethal take of individuals of these species to result in population-level consequences to bowhead, fin, and humpback whales.

Because we do not anticipate a reduction in numbers or reproduction of these whale species as a result of the proposed activities associated with the proposed USCG PSC Program that we determined were likely to result in adverse effects to these species, a reduction in the likelihood of survival for fin, humpback (Western North Pacific and Mexico DPSs), and bowhead whale is not expected.

There is no recovery plan for bowhead whales at this time.

The 2010 Final Recovery Plan (NMFS 2010) for the fin whale identifies the following recovery goals:

- Achieve sufficient and viable population in all ocean basins.
- Ensure significant threats are addressed.

The 1991 Final Recovery Plan (NMFS 1991) for the Humpback Whale identifies four recovery goals:

- Maintain and enhance habitats used by humpback whales currently or historically.
- Identify and reduce direct human-related injury and mortality.
- Measure and monitor key population parameters.
- Improve administration and coordination of recovery program for humpback whales.

No significant changes in habitat, extent or magnitude of threats to ESA-listed whales, or reductions in populations of fin, humpback, or bowhead whales are anticipated as a result of the action. Sighting and survey information indicate that populations of these species have increased in the action area and specifically in the Arctic operation area. Because no mortalities or effects on the distribution or reproduction of these species are anticipated as a result of the action, we do not anticipate that the action will impede the recovery objectives for those species with a recovery plan. Even though there is no recovery plan for bowhead whales, we also do not anticipate that the effects associated with the action will cause a reduction in the likelihood of recovery of bowhead whales in the wild.

### 10.1.2 Ice Seals

Arctic ringed and Beringia bearded seals are present year-round in the Arctic operation area and share similar behaviors and ecology. Ringed and bearded seals are expected to be exposed to the same stressors from the small vessel speeds and helicopter operations associated with the activities specified above. As discussed in Section 8.3, we expect the responses of these seal species to these stressors to be similar. In addition, ringed seals are also expected to be exposed to stressors associated with the physical impacts of icebreaking activities on sea ice, including areas of sea ice proposed for designation as critical habitat for Arctic ringed seals.

No reduction in the distributions of these two ice seal species is expected as a result of the proposed activities in the Arctic operation area.

In the 2017 Marine Mammal Stock Assessment Report, Muto et al. (2018) note that regression modeling and a trend analysis (Frost et al. 2002) suggested density declines of 50 to 72 percent on shorefast ice and 31 to 43 percent on pack ice over a 15-year period from 1985 to 1999. However, the apparent decline between the 1980s and 1990s may have been due to a difference in timing of surveys rather than actual abundance of animals (Frost et al. 2002; Kelly et al. 2006). Current and reliable data on trends in population abundance for the Alaska stock of ringed seals are considered unavailable (Muto et al. 2018). Similarly, a reliable population estimate for the Alaska stock of bearded seals is not available and trends in population abundance are not possible to determine (Muto et al. 2018). However, minimum population estimates have been determined as 170,000 ringed seals and 273,676 bearded seals for the U.S. Bering Sea (Muto et al. 2018).

While any life stages of ringed and bearded seals, which are present year-round in the Arctic operation area, might be affected by non-lethal take in the form of harassment of 520 individuals of each species, none of these animals will be targeted by the proposed activities and non-lethal take is anticipated to have short-term consequences with the exception of noise from icebreaking that may result in long-term injury and will be discussed further in a step-down consultation. The anticipated non-lethal take of 520 ringed and 520 bearded seals, if of sexually mature males and/or females, could lead to a loss of reproduction at an individual level if, for example, harassment interrupted mating or led an animal to flee an area during mating season. However, this loss is not expected to last all season in a given year because the icebreaker will continue moving through the area.

The mortality of up to 10 Arctic ringed seals, likely females and/or pups, over a five-year period as a result of physical effects of icebreaking will lead to a loss of reproduction at an individual level associated with the loss of sexually mature females. Despite this potential permanent loss of sexually mature ringed seals and the potential temporary loss of sexually mature bearded and ringed seals, given the current population sizes of these species in the Arctic operation area, the population of ringed and bearded seals in the area would not be appreciably affected. Likewise, the reduction in reproduction that could occur temporarily due to non-lethal take in the form of harassment or permanently due to mortality associated with physical impacts to ringed seals from icebreaking would not appreciably affect reproductive output of these species in the Arctic.

The action will not affect the species' current geographic range. Despite the lack of adequate population estimates for these ice seal species, the lethal take of 37 and non-lethal take of 520 ringed seals and the non-lethal take of 520 bearded seals is not expected to exceed 0.33 and 0.19 percent of the total abundance of Arctic ringed and Beringia bearded seals, respectively, in waters within the Arctic operation area. For this reason, we do not expect the non-lethal take of individuals of these species to result in population-level consequences to Arctic ringed seals and Beringia bearded seals.

There is no recovery plan for Arctic ringed and Beringia bearded seals at this time.

However, because we do not anticipate a significant reduction in numbers or reproduction of these ice seal species as a result of the proposed activities associated with the proposed USCG PSC Program that we determined were likely to result in adverse effects to these species, a reduction in the likelihood of survival Arctic ringed seals and Beringia bearded seals is not expected. Therefore, we conclude that the action will not cause a reduction in the likelihood of recovery of Arctic ringed and Beringia bearded seals in the wild.

### 10.2 Analysis of Damage and Adverse Modification of Proposed Critical Habitat for Arctic Ringed Seal

When determining the potential impacts to critical habitat for this Opinion, NMFS relies on the regulatory definition of "destruction or adverse modification" of critical habitat from the revised regulations issued by NMFS and USFWS (84 FR 45016) on August 27, 2019. Under the revised regulations, destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

Ultimately, we seek to determine if, with the implementation of the actions, critical habitat would remain functional (or retain the current ability for the essential features to become functional) to serve the intended conservation role for the species. This analysis takes into account the geographic and temporal scope of the actions, recognizing that "functionality" of critical habitat necessarily means that it must now and must continue in the future to support the conservation of the species and progress toward recovery. The analysis must take into account any changes in amount, distribution, or characteristics of the critical habitat that will be required over time to support the successful recovery of a/the species.

Within the proposed critical habitat area for Arctic ringed seals, there are approximately 350,000 $mi^2$ (906,496 $km^2$) of shorefast ice, stable pack ice, and snowdrift habitat with some open water for foraging that may be used by this species. The essential features for the conservation of Arctic ringed seals that are the basis for the critical habitat designation are:

- The availability of sea ice habitat suitable for the formation and maintenance of subnivean birth lairs used for sheltering pups during whelping and nursing
- The availability of sea ice habitat suitable as a platform for basking and molting
- The availability of primary prey resources to support Arctic ringed seals

The seasonality and availability of ice cover strongly influences Arctic ringed seal movements, foraging, reproductive behavior, and vulnerability to predation. High quality, abundant food is important to the annual energy budget of ringed seals in part because animals typically lose a significant proportion of their blubber mass from spring to early summer and need to replenish their reserves by increasing feeding in late summer, fall, and winter. As noted in the rule proposing the designation of Arctic ringed seal critical habitat (79 FR 73010; December 9, 2014), several categories of human activities and associated threats may affect each of the features identified as essential to the conservation of Arctic ringed seals. These activities include: greenhouse gas emissions; oil and gas exploration, development, and production; shipping and transportation; and commercial fishing. Of these, greenhouse gas emissions are the principal threat to the persistence of Arctic ringed seals because of the ongoing and anticipated loss of sea ice and on-ice snow cover stemming from climate change.

The loss of the essential feature or a diminution in the function of the essential feature related to sea ice habitat for constructing subnivean lairs affects the reproductive success of Arctic ringed seals because substrate for sheltering pups and allowing them to grow to be weaned is lost or unavailable. The loss of the essential feature or a diminution in the function of the essential feature related to sea ice habitat for basking and molting increases the risk of predation if seals have to do this on land and also increases the energetic costs if seals have to do it in water (where it might not be possible) because molting is a biologically important, energy-intensive process. Without the annual molt, seals would be at increased risk from parasites and disease, which would also have consequences for reproductive success and survival. The loss of the essential feature or a diminution in the function of the essential feature related to primary prey resources, which are essential in meeting the annual energy budgets of Arctic ringed seals, would also have consequences for reproductive success and survival.

Therefore, the key conservation objectives of the proposed Arctic ringed seal critical habitat are to ensure the availability of sites for rearing of offspring, space for individual and population growth and to allow for normal behavior, and prey to meet nutritional requirements. To this end, our analysis seeks to determine whether or not the action is likely to adversely modify proposed critical habitat in the context of the status of proposed critical habitat for Arctic ringed seal (Section 6.2.5), the *Environmental Baseline* (Section 7), *the Effects of the Action* (Section 8), and *Cumulative Effects* (Section 9). Ultimately, we seek to determine if proposed critical habitat would remain functional to serve the intended conservation role for the species with the implementation of the action, or whether the conservation function and value of critical habitat is appreciably diminished through alterations to the physical or biological features essential to the conservation of a species or because of significant delays in the development of these features.

The first step in the analysis is to evaluate the action's expected effects on the species' ability to recover, facilitated by the availability of the essential feature. This analysis also takes into account the temporal scope of the action recognizing that "functionality" of critical habitat necessariliy means that it is now and will continue in the future to support the conservation of the species and progress toward recovery.

The action, specifically the physical effects related to icebreaking activities, will impact 22.75 $km^2$ per year, for a total of 910 $km^2$ of impacts over the expected 40-year lifetime of this consultation. Breakage of ice that is part of the proposed critical habitat for Arctic ringed seals may be in a specific area in a given year or in patches throughout the proposed critical habitat area depending on the locations where icebreaking is needed to maintain shipping lanes and other navigation areas and/or escort vessels. This loss of a very small proportion of the essential features of shorefast and stable pack ice for the construction of subnivean lairs and for basking and molting each year is not expected to be permanent in a given area as icebreaker activities will be conducted throughout the Arctic operation area depending on need, and sea ice is likely to reform over the winter when icebreaking is not proposed at this time. Even if an area of sea ice impacted by icebreaking did not reform or reformed but was not of the quality necessary for ringed seals to construct subnivean lairs in particular, this would not appreciably reduce the ability of proposed ringed seal critical habitat to function.

In terms of the primary prey items that are also an essential feature of the proposed critical habitat for ringed seals, we expect impacts to these resources associated with noise from icebreaking activities, which will be analyzed in more detail in a step-down consultation when more details about these effects are known as explained in this Opinion. However, these impacts are not expected to result in measurable reductions in the distribution and availability of primary prey species that serve as critical habitat for Arctic ringed seals based on the small area of impacts associated with icebreaking activities each year versus the large distribution of these prey species as well as the fact that they do not remain in a single location within a given year or year-to-year. Thus, we believe that limited annually occurring adverse effects to proposed critical habitat for Arctic ringed seal as a result of the action will not appreciably diminish the functionality of the habitat or the ability of the essential features to support the conservation functions of the habitat. Specifically, we do not expect the availability of sites for rearing of offspring, space for individual and population growth and to allow for normal behavior, and prey to meet nutritional requirements will be lost to a measurable extent as a result of the action.

# 11 CONCLUSION

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the action, and cumulative effects, it is NMFS biological opinion that the action is not likely to jeopardize the continued existence of bowhead whales, fin whales, humpback whales (Western North Pacific and Mexico DPSs), Arctic subspecies ringed seals, Beringia DPS bearded seals, or result in the destruction or adverse modification of proposed critical habitat for the Arctic subspecies ringed seal.

It is also NMFS biological opinion that the action is not likely to adversely affect the following species and designated critical habitats: bocaccio (Puget Sound Distinct Population Segment [DPS]); chinook (Sacramento River Winter-Run, Upper Columbia River Spring-Run, Snake River Spring/Summer-Run, Snake River Fall-Run, Central Valley Spring-Run, California Coast, Puget Sound, Lower Columbia River, and Upper Willamette River Evolutionary Significant Units [ESUs]), chum (Hood Summer-Run and Columbia River ESUs), coho (Central California Coast, Southern Oregon/Northern California Coasts, Lower Columbia River, and Oregon Coast ESUs), sockeye salmon (Snake River and Ozette Lake ESUs) and Atlantic (Gulf of Maine DPS) salmon; Pacific eulachon (Southern DPS); steelhead trout (Southern California, Upper Columbia River, Snake River Basin, Middle Columbia River, Lower Columbia River, Upper Willamette River, South-Central California Coast, Central California Coast, Northern California, California Central Valley, Puget Sound DPSs); yelloweye rockfish; giant manta ray; Nassau grouper; Oceanic whitetip and scalloped hammerhead (Northwest and Western Central Atlantic, Southwest Atlantic, Eastern Atlantic, Indo-West Pacific, Central Pacific, and Eastern Pacific DPSs), and daggernose sharks; blackchin guitarfish; narrow and smalltooth sawfish; Gulf, shortnose, green (Southern DPS), and Atlantic sturgeon (Chesapeake Bay DPS and Gulf of Maine DPS); lobed star, mountainous star, boulder star, elkhorn, staghorn, pillar, and rough cactus corals; ESA-listed Pacific corals: *Acropora globiceps*, *Acropora lokani*, *Acropora retusa*, *Acropora speciosa*, *Euphyllia paradivisa*, *Isopora crateriformis*, *Seriatopora aculeata*, and *Siderastrea glynni*; black and white abalone; leatherback, hawksbill, green (North Atlantic, South Atlantic, East Indian-West Pacific Ocean, Central North Pacific Ocean, Central South Pacific Ocean, East Pacific Ocean, Southwest Indian Ocean, and Southwest Pacific DPSs), Kemp’s ridley, olive ridley (Mexico’s Pacific coast breeding population and all other populations), and loggerhead (North Pacific Ocean, South Pacific Ocean, Northwest Atlantic Ocean, Northeast Atlantic, Southwest Indian Ocean, and Southeast Indo-Pacific Ocean DPSs) sea turtles; blue, gray (Western North Pacific DPS), humpback (Central America DPS), North Pacific right, North Atlantic right, Southern right, false killer (Main Hawaiian Island Insular DPS), sei, killer (Southern Resident DPS), and sperm whales; Steller (Western DPS) sea lion; Guadalupe fur and Hawaiian monk seals; North Pacific right whale critical habitat; Southern Resident killer whale critical habitat; Steller sea lion critical habitat; Hawaiian monk seal critical habitat; elkhorn and staghorn coral critical habitat; green sturgeon Southern DPS critical habitat; and proposed critical habitat for the Western North Pacific, Central America, and Mexico DPS of humpback whales.

# 12 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species without an exemption. “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity (50 C.F.R. §402.02). Section 7(o)(2) provides that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

## 12.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent, of such incidental taking on the species (50 C.F.R. §402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by actions while the extent of take specifies the impact, i.e., the amount or extent of such incidental taking on the speices, which may be used if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (see 80 FR 26832).

We anticipate the USCG PSC Program for the construction and operation of six new icebreakers are reasonably likely to result in the incidental take of ESA-listed species by death, injury, or harassment. Specifically, we anticipate the following annual take of ESA-listed cetaceans and ice seals in the Arctic operation area:

- Lethal take of up to 10 Arctic ringed seals (likely up to 2 in the Chukchi-Beaufort Seas and 8 in the Bering Sea) due to death, injury, or harassment associated with the physical effects of icebreaking over a five-year period. This would equate to up to 80 animals over the 40-year consultation period.
- Non-lethal take of 20 fin whales due to harassment. This would equate to up to 800 animals over the 40-year consultation period.
- Non-lethal take of 19 humpback whales (Western North Pacific and Mexico DPSs). This would equate to 760 animals over the 40-year consultation period.
- Non-lethal take of 375 bowhead whales. This would equate to 15,000 animals over the 40-year consultation period.
- Non-lethal take of 520 Arctic ringed seals. This would equate to 20,800 animals over the 40-year consultation period.
- Non-lethal take of 520 Beringia bearded seals. This would equate to 20,800 animals over the 40-year consultation period.

The take listed above does not exempt noise resulting from icebreaking activities for which adverse effects are expected to occur but have not yet been quantified and thus will be determined during a step-down consultation. We cannot determine at this time at what levels take resulting from icebreaking noise will occur from icebreaking activities until NMFS and the USCG have agreed on a method to calculate potential acoustic effects and the severity of these effects on ESA-listed marine mammals.

Similary, the following activities are included in this consultation but their adverse effects, including related to acoustic stressors, cannot be fully analyzed until the USCG has obtained funding, authorization (including from NMFS Permits and Conservation Division), or is implementing them:

- Icebreaking
- Ice condition testing
- Bollard condition testing
- Vessel escort and tow
- Aircraft operations.

Therefore, step-down consultations will likely be required for the implementation of these activities as the new icebreakers are delivered if the project-specific analysis for each new icebreaker indicates that additional PDCs and/or incidental take authorization is necessary for some or all of these activities in the future. Changes in homeport location and transit routes within the action area may also require step-down consultations in order to fully analyze levels of take.

Section 7(b)(4)(C) of the ESA provides that take of ESA-listed marine mammals may be included in the ITS of a biological opinion only if the taking is authorized under section 101(a)(5) of the MMPA. While we anticipate impacts to ESA-listed marine mammals from some of the proposed activities, none of the take noted above can occur until and unless MMPA authorization is granted.

No death is expected for any individual cetacean exposed to stressors from the action. Although our exposure analysis for cetaceans did not differentiate between TTS and behavioral harassment, TTS can include temporary damage/impairment to the inner ear epithelium, which constitutes harm under the ESA even though it is non-lethal and considered recoverable. Therefore, because both TTS and behavioral harassment are non-lethal, we do not distinguish between these two forms of take considered under the MMPA in this ITS. The non-lethal take of cetaceans specified above may be in the form of either TTS or behavioral harassment.

The take expected to result from the action has been quantified in terms of numbers of individuals expected to be taken. However, it is not practicable in all cases to monitor the take in terms of individuals. In these circumstances, our regulations allow us to use a surrogate measure: "A surrogate (e.g., similarly affected species or habitat or ecological conditions) may be used to express the amount or extent of anticipated take provided that the biological opinion or incidental take statement: Describes the causal link between the surrogate and take of the listed species, explains why it is not practical to express the amount or extent of anticipated take or to monitor take-related impacts in terms of individuals of the listed species, and sets a clear standard for determining when the level of anticipated take has been exceeded." 50 CFR §402.14(i)(1)(i).

To provide a clear standard for determining when the level of anticipated take has been exceeded for Arctic ringed seals from physical impacts of icebreaking activities, we describe below the surrogate measures that will be used to monitor the predicted take and ensure it does not exceed the limit of 10 animals over a five-year period, and how the surrogates comply with the regulatory requirement.

- Because it may not be possible to observe and count ringed seals in subnivean lairs in areas where icebreaking activities take place, the surrogate for take of Arctic ringed seals will be a proportion of the size of the sea ice area or areas directly impacted by icebreaking activities that contain the essential feature of the proposed critical habitat for Arctic ringed seals associated with the construction of subnivean birth lairs. This means any seasonal landfast (shorefast) ice (that is not bottomfast ice extending seaward from the coast line in waters less than 2 m deep) and any dense, stable pack ice that has undergone deformation. Both types of ice should contain snowdrifts at least 1.77 ft deep. Estimates of the number of ringed seal structures from monitoring associated with an oil exploration project found an average of 0.54 structures per $km^2$ with less than half of these being lairs in 1999 and 2000 (Richardson and Williams 2004). This means there could be approximately 0.27 lairs per $km^2$. This density should be used in combination with the area of sea ice (meeting the description of the most likely habitat for construction of birthing lairs) impacted by icebreaking to calculate the take of ringed seals in a given year. If the amount of icebreaking increases from that described in this Opinion or the size of the affected area is greater than estimated in this Opinion, reinitiation of consultation with NMFS is required to determine whether these differences will result in an exceedance of take for Arctic ringed seals associated with physical impacts from icebreaking activities.
- For the specified helicopter operations and fast moving support vessel activities specified in Section 8.3, a surrogate for take is not required. These activities will have lookouts monitoring for ESA-listed marine mammals who will report observations of animals and behaviors in order to ensure take of fin whales, humpback whales, bowhead whales, ringed seals, and bearded seals estimated in this Opinion is not exceeded.

### 12.2 Reasonable and Prudent Measures

The measures described below are nondiscretionary, and must be undertaken by the USCG and NMFS Permits and Conservation Division so that they become binding conditions for the exemption in section 7(o)(2) to apply. Section 7(b)(4) of the ESA requires that when an agency action is found to be consistent with section 7(a)(2) of the ESA and the action may incidentally take individuals of ESA-listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. To minimize such impacts, RPMs, and Terms and Conditions to implement the measures, must be provided. Only incidental take resulting from the agency actions and any specified RPMs and Terms and Conditions identified in the Incidental Take Statement are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

Reasonable and prudent measures are nondiscretionary measures to minimize the amount or extent of incidental take (50 C.F.R. §402.02). NMFS believes the reasonable and prudent measures described below are necessary and appropriate to minimize the impacts of incidental take on fin whales, humpback whales (Western North Pacific and Mexico DPSs), bowhead whales, Arctic ringed seals, and Beringia bearded seals:

1. The USCG and NMFS Permits and Conservation Division shall implement mitigation, monitoring, and reporting measures to limit the potential for interactions with ESA-listed cetaceans and ice seals that may rise to the level of take as a result of the actions described in this Opinion.

2. The USCG shall incorporate standards and procedures into policy and guidance, directives, and SOPs associated with the PSC Program, including operation of vessels and aircraft.

3. The USCG and NMFS Permits and Conservation Division shall report all observed interactions with ESA-listed cetaceans and ice seals resulting in take associated with implementation of the proposed PSC Program activities and any observations of stranded or dead ESA-listed marine mammals that are not attributable to USCG icebreaker operations described in this Opinion but are observed during the course of USCG activities and while implementing monitoring requirements of this Opinion and any MMPA authorizations.

4. The USCG and NMFS Permits and Conservation Division shall report all activities as required by this Opinion and as noted below in the Terms and Conditions.

5. The USCG and NMFS Permits and Conservation Division shall report any activities not included in the Description of the Action (Section 3) and/or any changes to the activities described in this Opinion prior to implementation and any exceedances of activity levels (Table 2) immediately upon determining that a planned activity may exceed these levels or that these levels have been exceeded. Exceedance of an activity may require reinitiation of consultation.

6. The USCG and NMFS Permits and Conservation Division shall continue to reduce the uncertainty related to the effects of icebreaking, both physical impacts to habitat and noise generated by the activities, on ESA-listed species and their habitats.

7. The USCG and NMFS Permits and Conservation Division shall monitor the effectiveness of the mitigation measures as described below in the Terms and Conditions.

### 12.3 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the USCG and NMFS' Permits and Conservation Division must comply with the following Terms and Conditions, which implement the RPMs described above. These include the take minimization, monitoring and reporting measures required by the section 7 regulations (50 C.F.R. §402.14(i)). These Terms and Conditions are non-discretionary. If the USCG and NMFS Permits and Conservation Division fail to ensure compliance with these Terms and Conditions to implement the RPMs associated applicable to the authorities of each agency, the protective coverage of section 7(o)(2) may lapse. The terms and conditions detailed below for each of the RPMs include monitoring and minimization measures where needed.

1. The USCG and NMFS Permits and Conservation Division shall implement all mitigation, monitoring, and reporting measures as described in Section 3 of this Opinion, including the appropriate PDCs, and any mitigation and conservation measures specified in final MMPA authorizations for the action.
   a. The USCG and NMFS Permits and Conservation Division shall ensure the implementation of the procedures described in Section 3.3.2 for project-specific review and step-down consultation.
   b. The USCG will work with NMFS ESA section 7 consulting biologist to adaptively manage amendments to the measures within this Opinion, programmatically or for a specific activity, project, or site-specific actions, as necessary, to ensure the protection of ESA-listed species through the annual review process.

2. The USCG shall ensure the avoidance and minimization measures developed for this consultation, including the PDCs, are incorporated into policy and guidance, directives, and SOPs associated with the operation of vessels and aircraft under the PSC Program, particularly for activities that have the potential to affect ESA-listed species. This updating of existing policy and practice for the PSC Program should be completed prior to commissioning of the first new icebreaker. The USCG shall also ensure necessary measures as identified in this Opinion or through step-down consultations are implemented to protect ESA-listed marine mammals.

3. The USCG and NMFS Permits and Conservation Division shall report all observed interactions with ESA-listed cetaceans and ice seals resulting in take associated with implementation of the proposed PSC Program activities The USCG and NMFS Permits and Conservation Division shall also reportany observations of stranded or dead ESA-listed marine mammals that are not attributable to USCG icebreaker operations described

in this Opinion observed during the course of USCG activities and while implementing monitoring requirements of this Opinion and any MMPA authorizations.

a. The USCG, in cooperation with NMFS Permits and Conservation Division, shall shall immediately contact the NMFS ESA section 7 consulting biologist and the appropriate stranding networks to report stranding details associated with death or injury of marine mammals due to icebreaker activities. Death or injury of marine mammals due to icebreaker activities may require reinitiation of consultation as lethal injury of animals other than ringed seals is not authorized in this ITS.
b. Observations of stranded or dead ESA-listed marine mammals while implementing monitoring requirements of this consultation and any MMPA authorization that are clearly not attributable to the PSC Program shall also be reported within 24 hours of the observation. Stranded or dead marine mammals in Alaska should be reported to the Alaska Region Stranding Program 24/7 hotline at 1-877-925-7773. On the West Coast, stranded or dead marine mammals should be reported to the West Coast Marine Mammal Stranding Hotline at 1-866-767-6114.

4. The USCG shall submit annual summary monitoring reports that identify the general location, timing, duration, and other aspects of the activities analyzed in this Opinion to help assess the actual amount or extent of take incidental to the implementation of PSC Program activities.
   a. The USCG, in conjunction with NMFS Permits and Conservation Division, shall provide an annual report to NMFS summarizing vessel and aircraft traffic data including approximate navigation routes and flight paths; PDCs implemented to avoid and minimize effects to ESA-listed marine mammals; and observer data with details on the number, locations, behaviors, responses to disturbance, and any other relevant information for each species encountered during the vessel and aircraft operations that were identified in this Opinion as likely to adversely affect ESA-listed marine mammals.
   b. The USCG shall provide an annual summary of the approximate area of ice broken along with the location(s); ice characteristics, particularly as they relate to habitat requirements of ringed seals for the construction of subnivean lairs; observer data, including details related to the presence and behaviors of ice seals, any evidence of the presence of structures in the ice, and any evidence of physical impacts to animals such as blood; and an estimation of the annual take of Arctic ringed seals from physical impacts to sea ice associated with icebreaking activities. The estimation of annual take shall use the surrogate measure described in Section 12.1.

5. The USCG shall report to NMFS any possible exceedance of anticipated activity levels (Table 2), planned implementation of activities not included in the *Description of the Action* (Section 3), and/or any changes to the activities described in this Opinion prior to

implementation immediately upon determining that a planned activity may exceed these levels or that these levels have been exceeded. Exceedance of activity levels, changes to activities and/or implementation of new activities that were not considered in this consultation may require reinitiation of consultation. Procedures for project-specific review and step-down consultation outlined in Section 3.3.2 should be followed to submit the required information to NMFS as soon as possible either prior to implementation or as soon as the USCG determines expected activity levels were exceeded.

6. The USCG and NMFS Permits and Conservation Division shall continue to update existing models such as NAEMO in coordination with the Navy (as the entity responsible for developing and maintaining NAEMO) and evaluate other models and methods to more effectively estimate the potential effects of icebreaking to ESA-listed marine mammals and critical habitat for ringed seals.

7. The USCG and NMFS Permits and Conservation Division shall monitor the effectiveness of the implementation of PDCs and any conservation measures developed for a specific location, project, or activity as part of step-down consultations. Effectiveness will be based on the ability of the USCG to implement the measure without modifications and the observer data collected during specific activities documenting ESA-listed marine mammal responses to each activity. As part of the annual reporting requirements, the USCG will identify any issues with implementation of avoidance and minimization measures, provide information regarding modifications that were made in the field to improve the effectivess of measures (if applicable), and make recommendations regarding the elimination of, need for modifications to, and/or need for development of measures to minimize the effects of take on ESA-listed marine mammals.

# 13 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of an action on ESA-listed species or critical habitat, to help implement recovery plans or develop information (50 C.F.R. §402.02).

The following conservation recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the USCG and/or NMFS Permits and Conservation Division:

1. We recommend that the USCG and NMFS Permits and Conservation Division work to make sighting data collected as part of the required monitoring and reporting available to the public and scientific community in an easily accessible online database that can be queried to aggregate data across required reports. Access to such data will help us to

better understand the biology of ESA-listed species in the action area including their range and will also inform future consultations and authorizations by providing information on the effectiveness of the conservation measures for different activities.

2. We recommend that the USCG work with NMFS to ensure training for crew members who serve as observers looking for ESA-listed species contains information regarding all ESA-listed species within the action area, including transit-only areas and areas where vessels are likely to use ports while in transit from one operation area to another. Training on the identification of ESA-listed species in the action area will assist in the implementation of required clearance zones between vessels and some ESA-listed species and their habitats.

3. We recommend that the USCG and NMFS Permits and Conservation Division update sighting logs to include information for accurately reporting observations of all ESA-listed sea turtles, marine mammals, and larger fish species (such as sharks and giant manta rays) that may be observed during transit of icebreakers between operation areas and provide sighting reports to NMFS for all observations. As for recommendation #1, this reporting would provide us with data to help us better understand the range of ESA-listed species in the action area.

4. We recommend the USCG and NMFS Permits and Conservation Division coordinate with researchers who perform scientific research using icebreakers as their platform to improve observations and reporting of ESA-listed species, assess the effectiveness of avoidance and minimization measures and suggest additional measures or modifications based on researcher expertise, and require reporting of any data collected as part of scientific support missions to NMFS to further improve our knowledge of the biology of listed species and the effectiveness of conservation measures.

5. We recommend the USCG continue to model potential impacts to ESA-listed species (including marine mammals, sea turtles, and fish), particularly in the three operation areas, through refinements of NAEMO and use of other relevant models; validate asummptions used in effects analyses; and seek new information and higher quality data for use in such efforts.

In order for NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their critical habitat, the USCG and NMFS’ Permits and Conservation Division should notify the Endangered Species Act Interagency Cooperation Division of any conservation recommendations they implement in their final action.

# 14 REINITIATION NOTICE

This concludes programmatic formal consultation for the USCG for the construction and operation of up to six new icebreakers and authorization for incidental take under the MMPA from NMFS Permits and Conservation Division. Consistent with 50 C.F.R. §402.16, reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

(1) The amount or extent of taking specified in the incidental take statement is exceeded.

(2) New information reveals effects of the agency action that may affect ESA-listed species or critical habitat in a manner or to an extent not previously considered. This includes the selection of a homeport other than Seattle, Washington or modifications to the Seattle homeport if this would result in effects to ESA-listed species or designated critical habitat that were not considered as potential adverse effects in this Opinion.

(3) The identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this Opinion.

(4) A new species is listed or critical habitat designated under the ESA that may be affected by the action.

(5) The effects to ESA-listed ice seals are greater than anticipated, which may also result in additional adverse effects to ESA-listed polar bears managed by the USFWS.

(6) Authorization under the MMPA is not granted for harassment or other effects to marine mammals or the MMPA application process results in changes to the project and resultant effects to ESA-listed species or designated critical habitats that were not considered in this Opinion.

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# APPENDIX A. QUANTIFYING ACOUSTIC IMPACTS FROM BE

QUANTIFYING ACOUSTIC IMPACTS ON MARINE MAMMALS: METHODS AND ANALYTICAL APPROACH

## 1 INTRODUCTION

This appendix describes the methods used to quantify potential effects to marine mammals from icebreaking activities. Sea turtles were not assessed for icebreaking sound exposure as their geographic ranges do not overlap any a proposed icebreaking areas. Other biological resources, such as birds, fish, and invertebrates that may potentially overlap with the proposed icebreaking area were not analyzed using this method because the model was developed for marine mammals so these resources were analyzed using qualitative methods. The description below includes all marine mammals, those under the USFWS' and NMFS' jurisdiction, since the methods were consistent for groups of marine mammal species. All results are provided in this appendix, but specific results for the NMFS species are provided in Section 4.1.4 of the BE.

Marine mammals are difficult to observe in real time and have varied behaviors based on species, geographic location and time of year. Furthermore, field-based information on the effects of icebreaking on marine mammals is unavailable. Therefore, mathematical modeling was necessary to estimate the number of marine mammals that may be affected by icebreaking activities. The Navy has invested considerable effort and resources analyzing the potential impacts of underwater sound sources (i.e., impulsive and non-impulsive sources on marine mammals and sea turtles). The Navy has used the Navy Acoustic Effects Model (NAEMO) since 1997 to model acoustic impacts to marine mammals. NAEMO has been refined since 1997 and documented in many environmental assessments and impact statements developed for Navy exercises. NAEMO was developed based on published research, collaboration with subject matter experts, and the Center for Independent Experts, an external peer-review system under the purview of NMFS.

## 2 DATA INPUTS TO THE MODEL

To run NAEMO, the model uses specific information about environmental conditions and the best available marine mammal data and quantifies potential impacts to marine mammals. The model also incorporated information collected by Roth et al. (2013) on the sound signature of CGC HEALY icebreaker and the proposed duration and timing of icebreaking activities. Environmental data often includes information about bathymetry, seafloor composition (e.g., rock, sand), and factors that vary throughout the year such as wind speed and underwater sound speed profiles. Marine mammal data includes densities, group sizes, and dive profiles. Lastly, the details of an activity are included (e.g., location, rate of occurrence, and source characteristics). Each of these inputs in described in more detail below.

## 3 LOCATIONS

For the purposes of this analysis, the NAEMO model incorporated location-specific variables in order to create an accurate representation of the marine environment where icebreaking activities would be expected to occur. The exact location of these activities would vary depending on ice cover, mission requirements, time of year, etc. Therefore, representative modeling "areas" were generated (one for the Arctic and one for the Antarctic) to define a location used for modeling purposes. These representative modeling areas were selected because the location provided environmental conditions such as open water, the ice edge, and ice covered areas where the icebreakers would be expected to occur. Although it is not known, at this time, the exact location of future icebreaking activities, these representative areas allow the model to assess impacts under conditions similar to those where the icebreaker would be expected to ice break. The Arctic modeling box was approximately 60 by 60 nm, and the Antarctic modeling area extends approximately 113 nm from McMurdo Station (Figure 1). Although the exact location of icebreaking may shift away from these representative areas that were used to model, the results are not expected to change significantly.

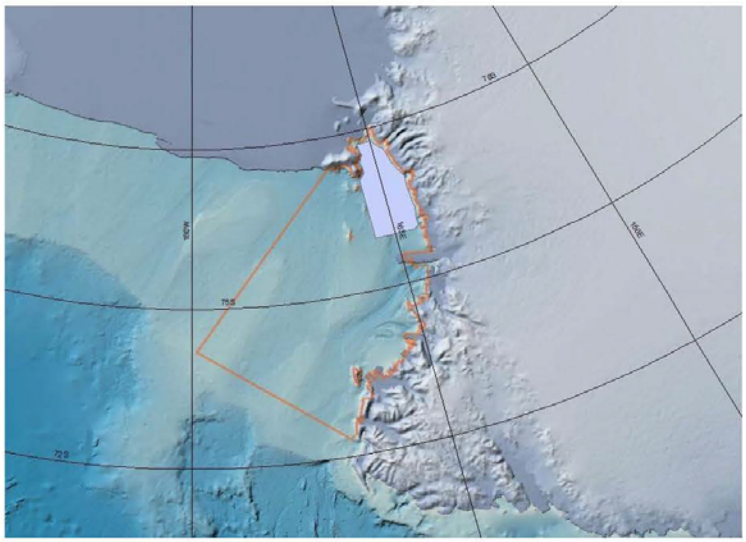

Figure 1. Representative modeling box for the Antarctic proposed action area.

## 4 PLATFORMS

Only ice breakers were modeled as platforms as part of NAEMO, all other platforms associated with the Proposed Action had included non-modeled acoustic sources. Typical platform speed and depth are accounted for in NAEMO.

## 5 ACTIVITIES AND EVENTS

Activities within NAEMO are further refined as "scenarios" which include data on the number of platforms, types and numbers of impulsive and non-impulsive sources, and source duration. Scenarios are then further defined as "events," which include details on location and frequency of occurrence. Section 4.1 of the EA provides additional information on how scenario and event definitions are implemented in NAEMO. In the NAEMO model, a scenario is what would happen in a 24-hour period. The event factors things such as hours or number of days. Thus, after a 24-hour period, the model resets.

## 6 SOURCE CHARACTERISTICS

### 6.1 Source Characteristics

Acoustic sources are divided into two categories, impulsive and non-impulsive. Impulsive sounds feature a rapid increase to high pressures, followed by a rapid return to static pressure. Impulsive sounds are often produced by processes involving a rapid release of energy or mechanical impacts (Hamernik and Hsueh 1991). Explosions and air gun impulses are examples of impulsive sound sources. Non-impulsive sound sources can be narrowband or tonal, brief or prolonged, continuous or intermittent, and lack the rapid rise time of impulsive sources. Ice breaking was considered a non-impulsive sound source. Non-impulsive sound sources include sonar and other transducers, which lack the rapid rise time of impulsive sources and can have durations longer than those of impulsive sounds can.

In addition to impulsive and non-impulsive, sources can be categorized as either broadband (producing sound over a wide frequency band) or narrowband (where the energy is within a single one-third octave band). Typically, broadband is equated with impulsive sources, and narrowband with non-impulsive sources, although non-impulsive broadband sources, such as acoustic communications equipment are also considered. Icebreaking was modeled as a non-impulsive broadband source. All non-impulsive sources were modeled using the geometric mean frequency. Only non-impulsive sources are discussed for the purposes of this analysis.

### 6.2 Non-Impulsive Sources

Non-impulsive sources are sonars and other transducers and include the following types of devices: submarine sonars, surface ship sonars, helicopter dipping sonars, torpedo sonars, active sonobuoys, countermeasures, underwater communications, tracking pingers, unmanned underwater vehicles and their associated sonars, and other devices.

The following terms were used to collect data on non-impulsive sources:

Source Depth – the depth at which a source goes active.

Source Level – the sound level of a source at a nominal distance of 1m, expressed in decibels referenced to one micropascal (dB re 1 μPa).

Nominal Frequency – typically, the geometric mean of the frequency bandwidth.

Source Directivity – the source beam was modeled as a function of a horizontal and a vertical beam pattern.

The horizontal beam pattern was defined by two parameters:

Horizontal Beamwidth – the width of the source beam in degrees measured at the 3-decibel (dB) down points in the horizontal plane (assumed constant for all horizontal steer directions).

Relative Beam Angle – the direction in the horizontal plane that the beam was steered relative to the platform's heading (direction of motion) (typically 0°).

The vertical beam pattern was defined by two parameters:

Vertical Beamwidth – the width of the source beam in degrees in the vertical plane measured at the 3-dB down points (assumed constant for all vertical steer directions).

Depth/Elevation Angle – the vertical orientation angle relative to the horizontal.

Ping Interval – the time in seconds between the start of consecutive pulses for a non-impulsive source.

Pulse Length – the duration of a single non-impulsive pulse, specified in milliseconds. Duty cycle is defined as ping interval/ pulse length.

Signal Bandwidth –The geometric mean frequency is the square root of the product of the frequencies defining the frequency band (see equation 1)

$$f_{gm} = (f_{min} \times f_{max})^{0.5} \quad (1)$$

where $f_{max}$ is the upper cutoff frequency and $f_{min}$ is the lower cutoff frequency.

Many of these system parameters are classified and cannot be provided in an unclassified document. Each source was modeled utilizing representative system parameters based on the non-impulsive source category within which it occurs.

*Source Bins*

Within NAEMO, non-impulsive sources are grouped into bins that are defined in accordance with their fundamental acoustic properties such as frequency, source level, beam pattern, and duty cycle. Each bin is characterized by the most conservative parameters for all sources within that bin. Specifically, bin characteristics for non-impulsive sources were selected based on (1) highest source level, (2) lowest geometric mean frequency, (3) highest duty cycle, and (4) largest horizontal and vertical beam patterns. Some sources are removed from quantitative analysis because they are not anticipated to result in takes of protected species include those of low source level, narrow beamwidth, downward-directed transmission, short pulse lengths, frequencies above known hearing ranges of marine mammals, or some combination of these factors.

The use of source classification bins provides the following benefits:

- Provides the ability for new sensors or munitions to be covered under existing authorizations, as long as those sources fall within the parameters of a "bin;"
- Allows analysis to be conducted in a more efficient manner, without any compromise of analytical results;
- Simplifies the source utilization data collection and reporting requirements under Marine Mammal Protection Act authorizations if necessary;
- Ensures a conservative approach to all impact estimates, as all sources within a given class are modeled at the lowest frequency, highest source level, longest duty cycle, or largest net explosive weight within that bin; and
- Provides a framework to support the reallocation of source usage (hours/explosives) between different source bins, as long as the total numbers of takes remain within the overall analyzed and authorized limits.

## 7 PHYSICAL ENVIRONMENT

The physical environment data described below plays an important role in the acoustic propagation used in the modeling process. Some of these characteristics (e.g. temperature, salinity) cannot be forecast far enough into the future with sufficient accuracy for the purpose of this analysis (the first icebreaker is expected as soon as 2023). Furthermore, the exact timing of icebreaking activities associated with the proposed action is unknown. Therefore, the model used historical data to define a typical environmental state for the boreal (Arctic) and austral (Antarctic) summer, the period when icebreaking is most likely to occur in those respective areas. Information on bathymetry, seafloor composition, temperature, salinity, and pressure were obtained from the Oceanographic and Atmospheric Master Library (OAML), an aggregation of smaller databases of oceanographic data, and then incorporated into NAEMO. Table B-1 provides the environmental parameters used in NAEMO for the proposed action.

*Bathymetry*

Bathymetry can affect sound propagation in a variety of ways. In a shallower area, sound will have more interaction with the bottom which will absorb some of the sound energy than it would in a deeper area. Furthermore, the slope of the seafloor determines the angle at which sound will be reflected off the bottom. Bathymetry was obtained at the highest resolution available, ranging from 0.05-2.0 arc-minutes.

*Seafloor Composition*

Seafloor composition can affect acoustic propagation calculations. Acoustic propagation paths in deep water usually do not interact with the seafloor, whereas in shallow waters, the bottom-type could influence whether sounds are absorbed or reflected. For example, a muddy bottom absorbs more energy and a rocky bottom reflects more energy. The central regions of the northern Bering Sea are characterized by fine and very fine sand, with coarser grained sand, gravel, and cobbles near the outer boundaries of the northern Bering Sea and Bering Strait (Grebmeier et al. 1989; Logerwell et al. 2015). Sediments in the Chukchi Sea are characterized by more heterogeneous fine sand/silt and clay sediments. The Ross Sea's irregular topography is composed of various distributions of silt, sand, glacial till and gravel, biogenic material, and scattered boulders (Clarke 1996). In the deeper regions of the continental shelf (greater than approximately 984 ft [300 m]), where bottom circulation remains weak, siliceous biogenic ooze, silt, and clay make up the primarily soft sediment substrate, unlike in shallower regions where stronger currents and glacial outlets give way to rougher gravel and sand (Anderson et al. 1984).

*Temperature, Salinity, and Pressure*

Temperature, salinity, and pressure affect the speed with which sound travels through the water. These variables mostly change with depth in the, resulting in a sound speed "profile." Sound speed profile data were extracted from the OAML at the highest database resolution of 0.25 degree over the extent of the modeling areas.

*Wind Speed*

Wind speed data are typically extracted from the Surface Marine Gridded Climatology data at the highest available resolution of one degree. Wind speed data are directly related to other environmental parameters, primarily the sound speed. However, because the proposed icebreaking area is assumed to be covered in ice, this is not applicable for NAEMO modeling.

*Seasonal Definitions*

Coast Guard activities are not limited to a specific month or season. Therefore, a seasonal approach was adopted to meet this requirement, given the impracticality of modeling each scenario for every month. The seasonal definitions that were employed were dictated by region and marine mammal presence detailed in U.S. Navy (U.S. Navy 2014). Seasons were defined as cold (December to May) or warm (June to November) in the Arctic and the opposite months of the year for the Antarctic. The seasonal averages were generated by linearly averaging the data for the months within a given season.

**Table 1. Environmental Parameters for Icebreaking in the Arctic and Antarctic**

| Model / Parameter | Data Input | Database |
|---|---|---|
| Propagation Model | Specific data are not applicable for this parameter. | Comprehensive Acoustic System Simulation Version 4.3b |
| Absorption Model | Specific data are not applicable for this parameter. | Francois-Garrison (the CASS/GRAB default) |
| Analysis Locations | Arctic representative modeling Area: lower left corner: 75.81, -149.26<br>upper right corner: 75.76, -145.20 | Database not used for this parameter |
| Analysis Specifics | Artic representative area | Database not used for this parameter |
| Bathymetry | Data was obtained from representative location in the Arctic (defined above). Resolution was 500m. | The International Bathymetry Chart of the Arctic Ocean (IBCAO) Version 3.0 |
| Sound Speed Profiles | Sound speed profiles were extracted at the highest database resolution 0.25 degree. | Generalized Digital Environmental Model Variable (GDEM-V) Version 3.0 |
| Wind Speed | Not applicable since covered in ice | Surface Marine Gridded Climatology (SMGC) Version 2.0 |
| Geo-Acoustic Parameters | Sediment type of medium sand was determined for the Arctic Area. | High Frequency Environmental Acoustics Version 2 HFEVA |
| Surface Reflection Coefficient Model | Specific data are not applicable for this parameter. | Navy Standard Forward Surface Loss Model |

| Model / Parameter | Data Input | Database |
|---|---|---|
| Propagation Model | Specific data are not applicable for this parameter. | Comprehensive Acoustic System Simulation Version 4.3b |
| Absorption Model | Specific data are not applicable for this parameter. | Francois-Garrison (the CASS/GRAB default) |
| Analysis Locations | Antarctic representative modeling Area: lower left corner: -77.76, 163.13<br>upper right corner: -75.94, 166.55 | Database not used for this parameter |
| Analysis Specifics | Antarctic representative area | Database not used for this parameter |
| Bathymetry | Data was obtained from representative location in the Antarctic (defined above). Resolution was 500m. | The International Bathymetry Chart of the Southern Ocean (IBCAO) Version 3.0 |

| | | |
|---|---|---|
| Sound Speed Profiles | Sound speed profiles were extracted at the highest database resolution 0.25 degrees. | Generalized Digital Environmental Model Variable (GDEM-V) Version 3.0 |
| Wind Speed | Not applicable since covered in ice | Surface Marine Gridded Climatology (SMGC) Version 2.0 |
| Geo-Acoustic Parameters | Sediment type of medium sand was determined for the Antarctic Area. | High Frequency Environmental Acoustics Version 2 HFEVA |
| Surface Reflection Coefficient Model | Specific data are not applicable for this parameter. | Navy Standard Forward Surface Loss Model |

# 8 BIOLOGICAL ENVIRONMENT

In NAEMO, marine species are represented by "animats," virtual animals used during modeling (Dean 1998). In order to simulate the behavior and spatial distribution of marine mammals, NAEMO requires data on their densities, group sizes, dive profiles, and body masses.

*Marine Mammal Density*

Information on species-specific distribution and abundance in the areas of interest is necessary to calculate the number of animals potentially affected by icebreaking activities. This information is most easily expressed as a density (e.g. number of animals per square kilometer), the number of animals of each species that may be present within a specific area and timeframe. Details on the density data and parameters input into NAEMO are provided in the Navy Marine Species Density Database (NMSDD) (U.S. Navy 2014, 2017a, 2017b). Density estimates for the Arctic and Antarctic, for certain species were often scarce, particularly, in the location where icebreaking would be expected to occur. As much as possible, modeling relied on field-based density estimates in or at least near to the representative locations for icebreaking. These include the most recent surveys of the Ross Sea published by the International Whaling Commission (IWC), seal density estimates compiled by the New Zealand Antarctic Institute, as well as various published estimates of Arctic species densities (Table 2). In cases where field-based density estimates did not exist, the model used densities from a Relative Environmental Suitability (RES) model (Kaschner et al. 2006). For some species RES densities could be compared to published field surveys conducted in the same general area as the representative location, for validation. It was assumed that although some of these field-based studies were conducted in locations in the Arctic and Antarctic, that the density estimate was the best available and representative for the appropriate modeling area in each proposed icebreaking location. For certain species, RES values were the only source of data. Therefore, in conjunction with NMSDD and when possible, densities were verified using published peer reviewed field surveys or published density models before input into the model.

**Table 2. Sources used for marine mammal density estimates**

| Species | Source |
|---|---|
| *Arctic* | |
| Bearded Seal | Kaschner et al., 2006. |
| Beluga Whale | Harwood, 1996. Duval, 1993. |

| | |
|---|---|
| Killer Whale | Kaschner et al., 2006. |
| Ringed Seal | Bengston et al., 2005. |
| Bowhead Whale | Kaschner et al., 2006. |
| Polar Bear | Taylor and Lee, 1995. Vongraven and Peacock, 2011. |
| *Antarctic* | |
| Blue Whale | IWC, 2003. |
| Fin Whale | IWC, 2003. |
| Humpback Whale | IWC, 2003. |
| Sei Whale | Kaschner et al., 2006. |
| Killer Whale | IWC, 2003. |
| Sperm Whale | IWC, 2003. |

*Group Size*

Many marine mammals are known to travel and feed in groups. NAEMO accounts for this behavior by incorporating species-specific group sizes into the animat distributions, and accounting for statistical uncertainty around the group size estimate. Group sizes were collected for each species via a search of the available peer reviewed literature and survey data. Standard deviations area also incorporated into NAEMO by randomly selecting a value from the poisson or lognormal distribution defined by the mean group size and standard deviation provided.

*Dive Profiles*

NAEMO accounts for depth distributions by changing each animat's depth during the simulation process according to the typical depth pattern observed for each species. Dive profile information was collected via literature search. This information is presented as a percentage of time the animal typically spends at each depth in the water column. During a simulation, each animat's depth is changed every 4 minutes to a value randomly selected by the probability density function described by its profile. At this time, NAEMO does not simulate horizontal animat movement.

*Criteria and Thresholds for Assessing Impacts*

Criteria and thresholds to assess impacts to marine mammals are synthesized from published study results (U.S. Navy 2017b) provides details on the derivation of the Navy's current impact criteria). These criteria and thresholds are used to assess potential effects to marine mammals and sea turtles in the analysis process.

## 9 Navy Acoustic Effects Model

The following sections discuss the acoustic analysis, marine species distribution, simulation, and outputs from each of the NAEMO modules.

## 9.1 Icebreaking

Since the icebreakers associated with the proposed action have not been constructed yet, the best available information on their acoustic "signatures" (i.e., the distribution and intensities of different sound frequencies emitted) included Roth et al.'s (2013) study of CGC HEALY conducted in the central Arctic Ocean. Icebreaking can occur under full power, half power, quarter power, etc. Because sound signatures were not correlated to the icebreaker's power when icebreaking, the Roth et al. (2013) study provided sound signatures of the icebreaker in 8/10 ice coverage and 3/10 ice coverage, which were used in the NAEMO model to represent full power and quarter power ice breaking, respectively. The sound signature of the 5/10 icebreaking activities, which would correspond to half-power icebreaking, was not reported in (Roth et al. 2013); therefore, the full-power signature was used as a conservative proxy for the half-power signature. See Table 2-1 of the EA for the timing and duration of the proposed icebreaking at these various power levels.

The sound signature of each of the ice coverage levels was broken into 1-octave bins (Table 3 and Table 4). In the model, each bin was included as a separate source. When these independent sources go active concurrently, they simulate the sound signature of CGC Healy. The modeled source level summed across these bins was 196.2 dB re 1 uPa at 1 m for the 8/10 signature and 189.3 dB re 1 uPa at 1 m for the 3/10 ice signature. These source levels are a good approximation of the icebreaker's observed source level (provided in Figure 4b of Roth et al. 2013). The full-power (8/10 ice coverage) signature was used for the half-power icebreaking, which provides a conservative estimate of the effects for half-power icebreaking. Each frequency and source level was modeled as an independent source, and applied simultaneously to all of the animats within NAEMO. Each second was summed across frequency to estimate sound pressure level (root mean square [$SPL_{RMS}$]). This value was incorporated into the behavioral risk function to estimate behavioral exposures. For permanent and temporary threshold shift determinations, sound exposure levels were summed over the duration of icebreaking (Table 7).

**Table 3. Modeled bins for 8/10 ice coverage (full power) for CGC HEALY**

| Frequency (Hz) | Source Level (dB re 1 uPa at 1 m) |
|---|---|
| 25 | 189 |
| 50 | 188 |
| 100 | 189 |
| 200 | 190 |
| 400 | 188 |
| 800 | 183 |
| 1600 | 177 |
| 3200 | 176 |

| | |
|---|---|
| 6400 | 172 |
| 12800 | 167 |

**Table 4. Modeled bins for 3/10 ice coverage (quarter power) for CGC HEALY**

| Frequency (Hz) | Source Level (dB re 1 u at 1 m) |
|---|---|
| 25 | 187 |
| 50 | 182 |
| 100 | 179 |
| 200 | 177 |
| 400 | 175 |
| 800 | 170 |
| 1600 | 166 |
| 3200 | 171 |
| 6400 | 168 |
| 12800 | 164 |

NAEMO accounted for the typical speed of the icebreaker while icebreaking at 4 knots. NAEMO also incorporated the number of days and hours of icebreaking during the Antarctic and Arctic missions (Table 5).

**Table 5. Total number of days and hours per day that an icebreaker would be expected to ice break or tow a vessel (in ice) in Arctic and Antarctic**

| Icebreaking | Antarctic | | Arctic | |
|---|---|---|---|---|
| | Number of Days | Number hours/day | Number of days | Number hours/ day |
| 8/10s ice cover | 4 | 16 | 10 | 16 |
| 3/10s icecover | 22 | 16 | 11 | 16 |
| Vessel Tow in Ice | | | | |
| | 1 | 4 | X | X |

## 9.2 Acoustic Analysis

In NAEMO, the Acoustic Builder module generates propagation data. First, it uses event definitions from NAEMO to extract source characteristics and environmental data for a given location. It then uses a standard resolution for a set of propagation analysis points in the event's location. For each analysis point, the Navy's standard propagation model (the Comprehensive Acoustic Simulation System/ Gaussian Ray Bundle [CASS/GRAB]) is run to generate a sound field for each source in the scenario. For non-impulsive sources the sound field data is saved in NAEMO and subsequently provided as input to Scenario Simulator.

### 9.3 Comprehensive Acoustic Simulation System/ Gaussian Ray Bundle

The CASS/GRAB model is used to determine the propagation characteristics for acoustic sources with frequenciesgreaterthan150Hertz(Hz). Keenan and Gainey (2015) described CASS as "a linear acoustics, range-dependent, ray-based eigenray model that calculates arrival structure, sound pressure, reverberation, signal excess, and probability of detection." NAEMO analyses use CASS in the passive propagation mode, that is, one-way propagation, rather than the active mode, which uses two-way propagation. CASS uses acoustic rays to represent sound propagation in a medium. As acoustic rays travel through the ocean, their paths are affected by mechanisms such as absorption, reflection, and reverberation, including backscattering, and boundary interaction. The CASS model determines the acoustic ray paths between the source and a particular location in the water. The rays that pass through a particular point are called eigenrays.

GRAB's role in the propagation model is to group eigenrays into families based on their surface/bottom bounce and vertex history (see Figure 2). For example, a ray that bounces off the surface and then off the ocean floor would be in a different family than a ray that bounces off the floor first and then the surface. Rays with no boundary interaction would be in yet another family. Once the eigenrays have been grouped into families, the ray path properties are integrated (source angle, arrival angle, travel time, phase, and amplitude) to determine a representative ray for each family. These properties are weighted prior to integration so that rays closer to the desired target depth have more weight. Each representative eigenray, based on its intensity and phase, contributes to the complex pressure field, and hence, to the total energy received at a point. The total received energy at a point is calculated by summing the modeled eigenrays. Figure 2 shows the representative eigenrays for the families shown in Figure 3. The total received energy at the receiving point (50 m depth, 1.4 km range) is calculated by summing the representative eigenrays. CASS/GRAB accommodates surface and bottom boundary interactions, but does not account for side reflections that would be a factor in a highly reverberant environment, such as a depression or canyon, or in a man-made structure, such as a dredged harbor. Additionally, as with most other propagation models except finite-element-type models, CASS/GRAB does not accommodate diffraction or the propagation of sound around bends.

CASS/GRAB generates a table of depth range points with an associated received level per location and per source. For non-impulsive sources, these received levels are used as input into Scenario Simulator.

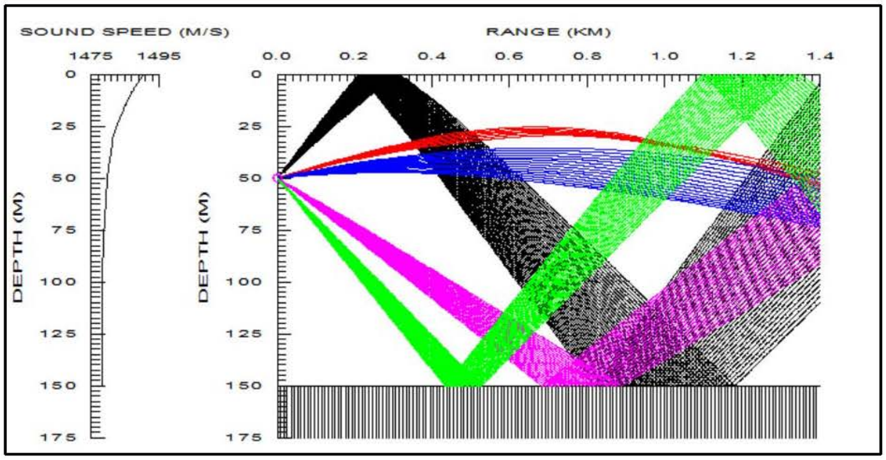


Figure 2. Colors represent distinct families of eigenrays identified by GRAB

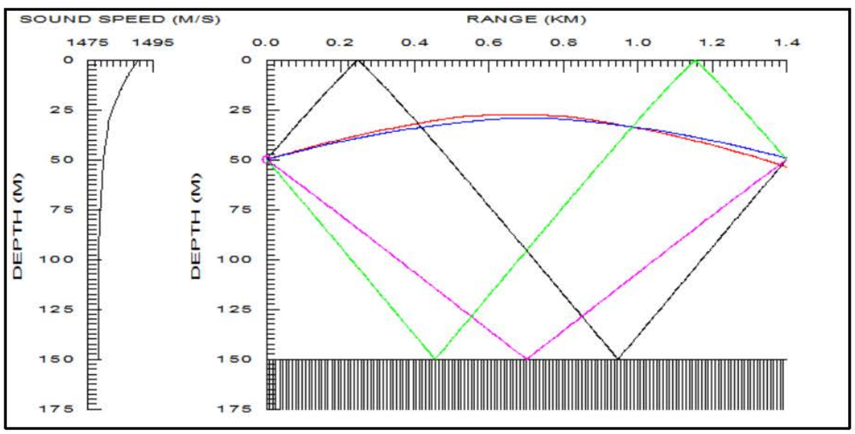


Figure 3. Representative eigenrays for the ray families in Figure 2.

### 9.4 Non-Impulsive Model

The following features were included in Acoustic Builder for non- impulsive events:

- Events can be visually inspected and verified before modeling begins. For example, Acoustic Builder allows the user to view an event's geographic location, range complex, platforms, sources, bathymetry, modeling boxes, and local species distributions.
- Users can select analysis points to be run by CASS/GRAB. This can be done automatically by giving Acoustic Builder spacing between points, which it uses to create a grid of equally spaced analysis points. Or, users can manually select analysis points.
- Acoustic Builder provides a graphical user interface for CASS/GRAB and runs the propagation model at every analysis point selected.
- Acoustic propagation is run along 18 equally spaced radials (bearing angles) from an analysis point to 100 km, or until the received level has reached 100 dB.

## 9.5 Marine Species Distribution Builder

Marine mammals are distributed into simulation areas with the representative locations for the proposed action areas (Arctic and Antarctic), and multiple iterations are run for each species to account for statistical uncertainty in the density estimates. Each iteration varies according to the standard error associated with the density estimate (U.S. Navy 2014). The density data are provided as a geographic grid (typically 10 km x 10 km) in which each cell is assigned a species density (animals/$km^2$). One density grid for each species was provided. In many cells, a standard deviation was provided with the density estimate. However, for areas where density predictions were made for non-surveyed areas, the density cells were so far away from any survey measurement that the estimated statistical uncertainty would not be meaningful. In these cases standard error was not provided. Group size and dive profiles were taken into account as discussed in Section 8. Animats were used during modeling to function as a dosimeter, recording energy received from icebreaking during a scenario.

The distribution of animats in NAEMO starts with the extraction of species density estimates by area and month. In order to incorporate statistical uncertainty surrounding density estimates into NAEMO, 30 distributions were produced for each species for each season (cold or warm), each of which varied according to the standard deviations provided with the density estimates. The following steps are then taken to distribute the animats within the defined modeling space.

- In each cell, the density estimate for that iteration is determined by randomly selecting a single value from a distribution defined by the density estimate (the mean of the distribution) and its standard deviation. If the density estimate did not have a corresponding standard deviation, the density remained constant at the mean for every iteration.
- The density estimate (animals/$km^2$) for that iteration is multiplied by the cells' area ($km^2$) to obtain the total number of animats in that cell.
- The total number of animats in each cell is summed across the entire area to determine the total number of animats in the entire area.
- Animats are placed into groups according to mean and standard deviation of group size. Groups are created until total abundance is reached.
- Groups of animats are then distributed into cells according to the probability density function defined by the original density estimates provided.

These steps result in a series of data files containing the time, location, and depth of each animat placed within the modeling area. The standard deviation was only used to vary the total number of animats in the entire region. This is necessary because, as a consequence of extrapolating the regression models into areas without survey measurements, the statistical uncertainty in these cells was substantially higher than in areas with survey measurements. An unrealistically high number of animats was often selected for these cells, which warped the population's spatial distribution.

## 9.6 NAEMO Simulation Process

The NAEMO simulation process combines all of the previously defined data and estimates the acoustic effects on marine mammals. The first module, Scenario Simulator, combines scenario definitions from Scenario Builder, data created in Acoustic Builder, and animat distributions created in Marine Species Distribution Builder to produce a record in NAEMO of the sound received by each animat. The second module, Post Processor, reads the record created by Scenario Simulator, applies the frequency-based weighting functions, and conducts a statistical analysis to estimate effects associated with each marine mammal group based on the specified criteria thresholds. Results from each analysis are stored in

NAEMO. The third and final module, Report Generator, provides a mechanism to assemble all of the individual species exposure records created by Post Processor and computes annual effect estimates. Estimated annual effects can be grouped by activity, season, and geographic region before outputting the results to comma-separated text files that can be used for further examination of the data. The following sections provide additional information for each module.

### 9.7 Monte Carlo Simulation Approach

Estimation of effects in NAEMO is accomplished through Monte Carlo simulations. This approach was chosen to account for the variability inherent in many factors of testing and training such as platform location and movement, precise location of modeling area, and instantaneous distributions of marine mammals. Additionally, NAEMO incorporates individual animat movement vertically in the water column at a specified displacement frequency for sufficient sampling of the depth dimension. Individual animats are not moved horizontally within NAEMO. The location of an event is randomly selected within a specified modeling area. NAEMO uses unique iterations of the simulated animal populations in each simulation, which allows it to provide sufficient sampling in the horizontal dimensions for statistical confidence. Monte Carlo simulations also produce statistically independent samples, which allows for the calculation of metrics such as standard error and confidence intervals. Thirty Monte Carlo simulations are run per event, per species, and per season. In each simulation, these factors are randomly selected:

- Modeling box (the area to which platforms are restricted)
- Geographic location of animats
- Depth of each animat (updated at 4 minute intervals during simulation)
- Platform start location within the modeling box
- Platform track (unless platform is stationary or its track is defined by waypoints)
- Time that source first goes active (unless timing is specified in scenario definition)

### 9.8 Scenario Simulator

The purpose of Scenario Simulator is to determine the level of sound received by each animat. This module references the scenario definition in NAEMO to determine the starting location, direction, and depth of each platform. Scenario Simulator then steps through time and integrates sources to determine which are actively emitting sound during that time step.

The simulation begins with a time equal to zero and progresses incrementally in 1-second steps until the end of the scenario. For each source, the beam pattern area and direction of sound source emission is computed. The beam pattern area is calculated from the horizontal beam pattern and maximum propagation distance, which are stored in the source table in NAEMO. The next step in the process identifies all animats that fall within each defined beam pattern area.

Propagation data are computed at multiple points within each modeling box to account for platforms moving during the simulation. The exception to this is scenarios that involve only stationary platforms. At each time step, the position of each platform is compared to the locations of each propagation analysis point to determine the closest propagation file.

For each animat identified in the beam pattern, a lookup in the sound source propagation file is performed to determine the received sound level for that animat. The lookup is conducted based on the bearing and distance from the platform to the animat and the depth of the animat. The closest matching point within the propagation file is used.

Simulation output for each animat is stored in NAEMO. These outputs include simulation time, platform name, source name, source mode name, source mode frequency, source mode level, ping length (not applicable in icebreaking), platform location (latitude/longitude), platform depth, species name, animal identification number, animal location (latitude/longitude), animal depth, animal distance from source, and sound received levels.

### 9.9 Post Processor

Post Processor uses output from Scenario Simulator to compute the impact of events on each marine mammal group. Criteria and thresholds are applied to Monte Carlo simulations which are then combined to provide a mean estimate of effects for each event.

Post Processor uses two metrics to describe sound received by animats, Sound Pressure Level (SPL) and Sound Exposure Level (SEL). Post Processor computes maximum SPL and accumulated SEL over the entire duration of the event for each animat. The maximum SPL, which is used to determine behavioral effects, is simply the maximum received level reported in Scenario Simulator. Accumulated SEL is used to determine PTS and TTS, and represents the accumulation of energy from all time-steps and from multiple source exposures. See Table 4-1 in the EA for the PTS and TTS thresholds used. For SEL, the appropriate auditory weighting functions defined by the marine mammal criteria are applied to adjust the received levels. SEL is given by:

$$\mathrm{SEL}_{s,t} = \mathrm{SPL}_{\mathrm{weighted},t} + 10 \times \log(PL_s) \tag{2}$$

Where $s$ is source $s$, $t$ is time $t$, $\mathrm{SPL}_{\mathrm{weighted},t}$ is the received level adjusted by the species auditory weighting function at time $t$, and $PL_s$ is the pulse length of source $s$. The SEL values are then power

$$\text{Cumulative } \mathrm{SEL}_s = 10 \times \log\left(\sum_{t=1}^{n} 10^{\mathrm{SEL}_{s,t}/10}\right) \tag{3}$$

summed across time to give a cumulative SEL for each source

where *n* is the number of time steps for the given source. After these calculations, the cumulative SEL is once more power summed across sources for each animat to determine the final cumulative SEL. A mean number of SPL and SEL simulated exposures are computed for each 1-dB bin. The mean value is based on the number of animats exposed at that dB level from each track iteration. The Behavioral Response Function (BRF) curve is applied to each 1-dB SPL bin to compute the number of behaviorally affected animats per bin (see Figure 4). The number of behaviorally affected animats per bin is summed to produce the total number of behavioral effects.

Mean 1-dB bin SEL exposures are then summed to determine the number of instances in which PTS and TTS thresholds were exceeded. PTS values represent the cumulative number of animats affected at or above the PTS threshold. TTS values represent the cumulative number of animats affected at or above the TTS threshold and below the PTS threshold. Each animat can only be reported under a single criterion (e.g., once an animat is reported for PTS, it would not additionally be reported under TTS or behavioral).

Because the exact distribution of individual animals and exact path of the ship during the icebreaking activities is not known, the modeling process randomly varied the distribution and track over the course of multiple simulations. By averaging the number of behavioral affects, TTS, and PTS across all simulations, results account for uncertainty in exact ship and animal location.

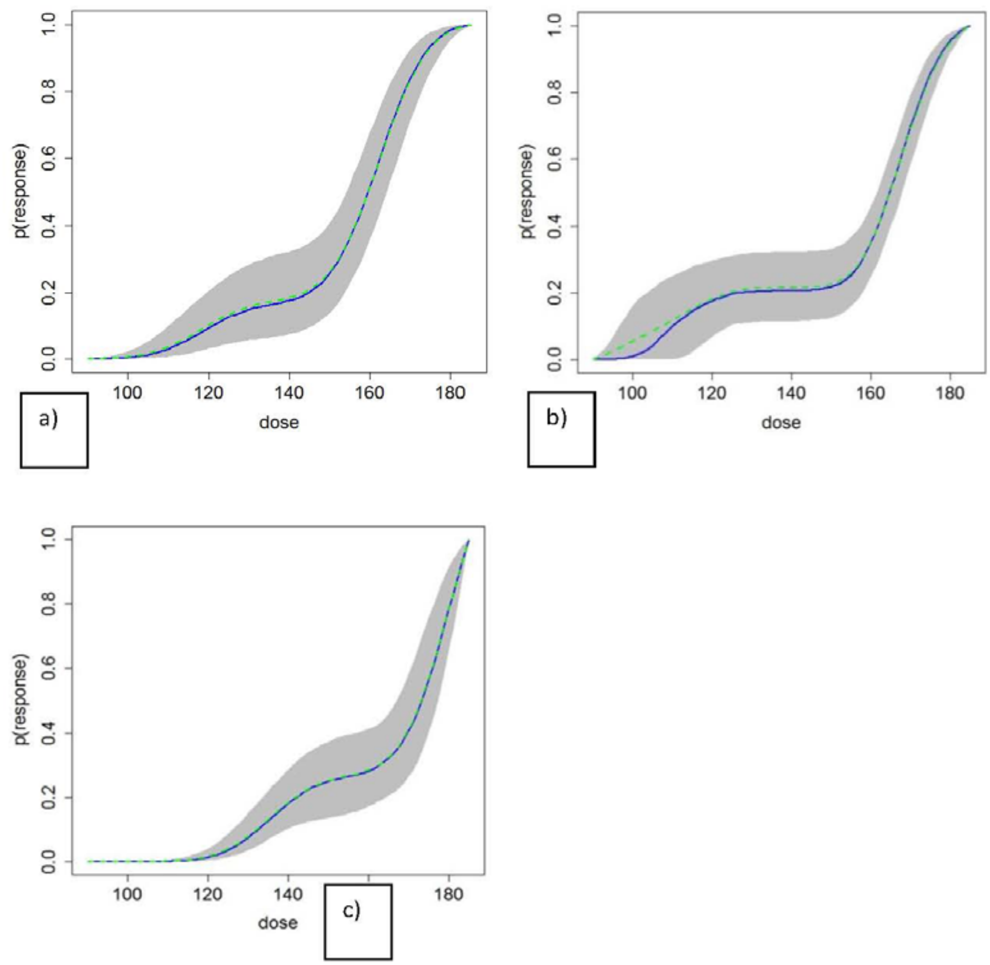


Figure 4. Dose-response BRG for a) odontocetes b) pinnipeds and c) mysticetes. The blue solid line represents the Bayesian Posterior median values, the green dashed line represents the biphasic fit, and the grey represents the variance. [X-Axis: Received Level (dB re 1 μPa), Y-Axis: Probability of Response]

## 9.10 NAEMO Modeling Results

All scenarios analyzed in NAEMO were evaluated as single events occurring within a given season and location. The annual estimated effects for a single scenario are determined by taking the average of all seasons and locations modeled for that scenario. To create the average effects, each scenario was multiplied by a factor based on the number of seasons, locations, and events per season that scenario would be conducted. Each factored scenario effect is then summed together to produce the average scenario effect. Total annual effects resulting from all scenarios modeled are then the summation of each scenario's averaged effect.

CASS/GRAB is the Navy's standard ray trace model for computing the propagation of sound in an underwater environment. As with any computational model there are inherent limitations on how and where the model should be used, particularly when it comes to modeling icebreaking.

The ship's specific position and heading is uncertain, at this time; however, in NAEMO a trackline was "assigned" for simulation purposes. For example, in the Antarctic, a representative route in the representative modeling location was used to simulate breaking into McMurdo Station. The maximum distance (100 km) or received level of 100 dB (see Section 9.4) was used to analyze acoustic propagation and transmission loss. For non-impulsive sources, NAEMO calculates the sound pressure level (SPL) and sound exposure level (SEL) for each active emission during an event. This is done by taking the following factors into account over the propagation paths: bathymetric relief and bottom types, sound speed, and attenuation contributors such as absorption, bottom loss, and surface loss. The icebreaker was modeled in accordance with relevant vehicle dynamics and time duration, and by moving it across the representative location area. An example of how range to effects was considered is provided using the Antarctic as the representative location. Table 6 provides the range to effects for icebreaking for marine mammals present in the Antarctic proposed action area relative to the TTS criteria, in SEL, for each hearing group. Range to effects to PTS was not calculated as modeling resulted in zero PTS. Marine mammals within the ranges presented in Table 6 would be predicted to receive the associated effect. Ranges included the duration, in seconds, ranging from 10 seconds to 3600 seconds (the maximum) and assumed the lowest possible speed, 2 knots, that the icebreaker might ice break. Realistically, the icebreaker would likely travel at $\geq$ 3 knots while icebreaking, but in calculating range to effects, the scheme that provided the most extreme of all of the possibilities was evaluated (i.e. slowest speed and longest duration). Of note, the noise produced by the icebreaker propagated in a radial pattern around the source (the icebreaker, see Figure 5).

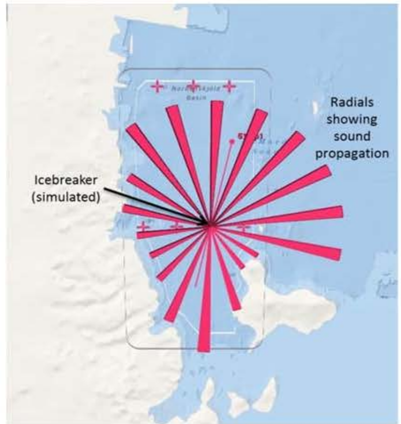


Figure 5. Representation of icebreaking sound as it propagates when breaking in to McMurdo Sound, Antarctica

Therefore, the ranges in Table B-6 provide realistic maximum distance over which TTS from icebreaking could be possible. This information predicts potential acoustic impacts, but also verifies the accuracy of model results (in this case, these were also measured against spherical spreading loss of 20 log r [20 times the log (base 10) of the radius (or range)]). Based on the range to effects TSS results, the number of takes anticipated for all marine mammal hearing groups in the Antarctic by TTS is rounded up to zero (see Table 7 for all results). The estimate for TTS takes were calculated by taking the area for TTS (the ratio of the circle circumference [acoustically the sound propagation radiated around the ship during icebreaking] and the maximum range for TTS) multiplied by the species density (/square kilometer).

Table 6. Range to Temporary Threshold Shift (TTS) in the Antarctic proposed action area.

| Hearing Group | Ice Cover | TTS Criteria (SEL) | Range to Effects (m) Maximum Range for TTS | Number of Takes [TTS]= area for TTS ($km^2$) x density (/sqkm) |
|---|---|---|---|---|
| Low Frequency Cetacean | 3/10 | 179 | 100 | 0 |
| | 8/10 | | 625 | 0 |
| Mid Frequency Cetacean | 3/10 | 178 | 20 | 0 |
| | 8/10 | | 30 | 0 |
| High Frequency Cetacean | 3/10 | 153 | 480 | 0 |
| | 8/10 | | 725 | 0 |
| Phocid (in water) | 3/10 | 181 | 35 | 0 |
| | 8/10 | | 95 | 0 |

As noted earlier, model outputs include the number of behavioral affects, TTS, and PTS per species and icebreaking scenario (8/10 ice cover and 3/10 ice cover). Results in Table 7 are the expected average for a single, annual patrol in the Arctic or Antarctic.

Table 7. Marine Mammal Acoustic Exposure from Icebreaking in the Arctic and Antarctic Proposed Action Areas

| Common Name | Behavioral | | TTS | | PTS | |
|---|---|---|---|---|---|---|
| | 8/10s ice cover | 3/10s ice cover | 8/10s ice cover | 3/10s ice cover | 8/10s ice cover | 3/10s ice cover |
| **Mysticetes** | | | | | | |
| *Arctic* | | | | | | |
| **Bowhead whale** | 1 | 1 | 0 | 0 | 0 | 0 |
| *Antarctic* | | | | | | |
| **Antarctic minke whale** | 49 | 224 | 0 | 0 | 0 | 0 |
| **Blue whale** | 3 | 12 | 0 | 0 | 0 | 0 |
| **Humpback whale** | 13 | 59 | 0 | 0 | 0 | 0 |
| **Minke whale** | 50 | 237 | 0 | 0 | 0 | 0 |
| **Odontocetes** | | | | | | |
| *Antarctic* | | | | | | |
| **Arnoux's beaked whale** | 50 | 275 | 0 | 0 | 0 | 0 |
| **Gray's beaked whale** | 5 | 29 | 0 | 0 | 0 | 0 |
| **Killer whale** | 45 | 169 | 0 | 0 | 0 | 0 |
| **Southern bottlenose whale** | 44 | 243 | 0 | 0 | 0 | 0 |
| **Pinnipeds and Carnivores** | | | | | | |
| *Arctic* | | | | | | |
| **Bearded seal** | 42 | 41 | 0 | 0 | 0 | 0 |
| **Polar bear** | 13 | 14 | 0 | 0 | 0 | 0 |
| **Ringed seal** | 764 | 810 | 0 | 0 | 0 | 0 |
| *Antarctic* | | | | | | |
| **Crabeater seal** | 404 | 1962 | | | | |

| Common Name | Behavioral | | TTS | | PTS | |
|---|---|---|---|---|---|---|
| | 8/10s ice cover | 3/10s ice cover | 8/10s ice cover | 3/10s ice cover | 8/10s ice cover | 3/10s ice cover |
| **Leopard seal** | 23 | 117 | 0 | 0 | 0 | 0 |
| **Ross seal** | 15 | 75 | 0 | 0 | 0 | 0 |
| **Weddell seal** | 18 | 90 | 0 | 0 | 0 | 0 |

## APPENDIX B. PROPOSED REVISIONS TO METHODS FOR QUANTIFYING ACOUSTIC EFFECTS TO MARINE MAMMALS

The information in this appendix was taken from questions and responses between NMFS and the USCG with assistance from the Naval Undersea Warfare Center, Naval Station Newport as part of communications that were ongoing as part of initiation of consultation and the development of the draft programmatic biological opinion.

The USCG has suggested the formation of a Working Group composed of subject matter experts from USCG, NUWC, NMFS, and other entities to determine how a 120 dB response curve could be incorporated appropriately into the NAEMO model. Currently, the only way the NAEMO model can incorporate a 120 dB threshold is using a harbor porpoise step-wise function, although it is not a species-specific calculation. The USCG did not model using 120 dB in the original acoustic analyses completed for the 2017 BE for the action. Instead, the USCG used 100 kilometers/100 dB to evaluate potential impacts to marine mammals from icebreaking. This is likely a more conservative approach than a 120 dB root mean square (rms) threshold. NMFS recommended using a simple area by density calculation using the distance to the 120 dB non-impulsive sound behavioral threshold as a more appropriate method to estimate take from icebreaking. NUWC noted that this would not take into account other noise such as from propellers, generated by the vessel while in operation that are accounted for in the NAEMO model.

NMFS applies a 0.1 step function set at 120 dB rms as the threshold potential behavioral harassment for icebreaking. That is, if exposed to noise below 120 dB rms, no harassment of marine mammals is expected. If exposed to noise above 120 dB rms, Level B harassment is expected and incidental take authorization under the MMPA is required. This threshold is primarily derived from bowhead whale data in the Arctic and so is relevant to the action.

The NUWC provided information from a rapid area by density calculation using source levels of the icebreaking vessel (196.2 dB for 8/10 ice cover and 189.3 dB for 3.10 ice cover) to determine the radial distance to the 120 dB threshold. Using spherical spreading, r = 6,456.54 m for 8/10 ice cover and 2,917.43 m for 3/10 ice cover.

The current analysis in the 2017 BE assumes that the probability of eliciting a behavioral response from individual animals to active transmissions would be a function of the received SPL (dB re: 1 uPa). This analysis also assumes that sound poses a negligible risk to marine mammals if they are exposed to SPLs below a certain basement value (e.g., 120 dB re: 1 uPa). In the analysis included in the BE, icebreaking was binned (see Table 3 in Appendix A) to account for the characterization of icebreaking as a broadband sound. Bins ranged from 25 kHz to 12,800 kHz with source levels ranging from 167 dB to 190 dB for full power, and 164 dB to 187 dB for quarter power. An additional calculation was done using this binning to determine the summed source level (Table B.1) as part of the examination of other methods for assessing potential acoustic impacts of icebreaking on marine mammals. A single frequency at a time can be modeled so the combined value is obtained by summing across the frequencies using the equation included in Table B.1.

**Table B.1. Updated Source Level Calculations Based on 8/10 Ice Coverage (Full Power) for CGC HEALY (adapted from Table 3 Appendix A to calculate summed source level, from USCG response January 30, 2019)**

| Update - 8/10 ICE COVERAGE | | |
|---|---|---|
| **Frequency(Hz)** | **Source Level (dB)** | **uPa** |
| 25 | 189 | 7.94328E+18 |
| 50 | 188 | 6.30957E+18 |
| 100 | 189 | 7.94328E+18 |
| 200 | 190 | 1E+19 |
| 400 | 188 | 6.30957E+18 |
| 800 | 183 | 1.99526E+18 |
| 1600 | 177 | 5.01187E+17 |
| 3200 | 176 | 3.98107E+17 |
| 6400 | 172 | 1.58489E+17 |
| 12800 | 167 | 5.01187E+16 |
| To calculate summed source level (SL), the following equation was used: $SL = 10 * Log10\left(10^{\frac{SL_1}{10}} + 10^{\frac{SL_2}{10}} + \cdots + 10^{\frac{SL_n}{10}}\right)$ Where 196.2 dB is the log sum of the source level. | | |

An under ice model for surface interaction was also implemented in NAEMO to account for sound propagation in the ice environment. In NAEMO, the Acoustic Builder generates propagation data. First, it uses event definitions from NAEMO to extract source characteristics and environmental data for a given location. It then uses a standard resolution for a set of propagation analysis points in the event's location. For each analysis point, the Navy's standard propagation model (the Comprehensive Acoustic Simulation System/Gaussian Ray Bundle [CASS/GRAB]) is run to generate a sound field for each source in a scenario. For non-impulsive sources like icebreaking, the sound field data are saved in NAEMO and then provided as input to the Scenario Simulator. NAEMO analyses use CASS in the passive propagation mode (one-way propagation), rather than the active mode (two-way propagation). CASS uses acoustic rays to represent sound propagation in a medium (ice or water in the case of the action). The CASS model determines the acoustic ray paths between the source and a particular location in the water. The rays passing through a particular point are called eigenrays. GRAB groups eigenrays into families in the propagation model based on their surface/bottom bounce and vertex history. Therefore, the USCG concluded that modeling icebreaking noise using NAEMO and CASS/GRAM is appropriate. CASS/GRAB has been used to predict the performance of sound sources operating in the 600 to 100kHz frequency.

The USCG acknowledged that there may be a concern for some of the lowest frequencies modeled that fall below the published lower frequency limit of CASS/GRAB, but the USCG and NUWC have discussed this with the model developer and others who noted that under certain conditions frequencies below the published lower limit (i.e., less than 150 Hz) can be accurately modeled. Those conditions include deep water such as that in the Arctic where icebreaking will occur. However, this will be another topic of discussion for the proposed Working Group.

The USCG remodeled using the harbor porpoise 120 dB. Using the harbor porpoise function, any received sound of 120 dB or greater that does not result in a TTS/PTS exposure would be classified as a behavioral effect 100 percent of the time for harbor porpoises. Any received sound below 120 dB is not classified as a behavioral effect 100 percent of the time. Applying this to icebreaking activity would mean any received sound of 120 dB and greater not resulting in a TTS/PTS effect would be reclassified as a behavioral effect for all species included in the Arctic icebreaking modeling because the USCG would assign the behavioral response step function to all species in the icebreaking activity rather than using the normal behavioral risk function curves. This is referred to as the Harbor Porpoise step function because that is the only species with a step function for its behavioral response. The results of the new modeling using the 120 dB step function versus the original calculations included in the BE are compared in Table B.2 for various marine mammal species expected to be in the Arctic and Antarctic operation areas. The numbers represent the expected number of MMPA takes for each species.

**Table B.2. Comparison of Behavioral Threshold Criteria Modeling Results from 2017 BE and the Behavioral Threshold Criteria Using the Harbor Porpoise 120 dB Step Function (from USCG response February 7, 2019)**

| Icebreaking Power | Location | Species | Behavior | Behavior |
|---|---|---|---|---|
| | | | Original Modeling | 120 Step function |
| Full/half | Arctic | Bearded seal | 42 | 273 |
| Full/half | Arctic | Beluga | 0 | 0 |
| Full/half | Arctic | Bowhead whale | 1 | 13 |
| Full/half | Arctic | Narwhal | 0 | 0 |
| Full/half | Arctic | Polar Bear | 13 | 291 |
| Full/half | Arctic | Ringed seal | 764 | 4802 |
| Quarter | Arctic | Bearded seal | 41 | 275 |
| Quarter | Arctic | Beluga whale | 0 | 0 |
| Quarter | Arctic | Bowhead whale | 1 | 10 |
| Quarter | Arctic | Narwhal | 0 | 0 |
| Quarter | Arctic | Ringed seal | 810 | 5366 |
| Full/half | Antarctic | Antarctic minke whale | 49 | 1505 |

| | | | | |
|---|---|---|---|---|
| Full/half | Antarctic | Arnoux beaked whale | 50 | 204 |
| Full/half | Antarctic | Blue whale | 3 | 80 |
| Full/half | Antarctic | Crabeater seal | 404 | 2719 |
| Full/half | Antarctic | Humpback whale | 13 | 383 |
| Full/half | Antarctic | Killer whale | 45 | 253 |
| Full/half | Antarctic | Leopard seal | 23 | 157 |
| Full/half | Antarctic | Minke whale | 50 | 1553 |
| Full/half | Antarctic | Ross seal | 15 | 99 |
| Full/half | Antarctic | Sei whale | 2 | 55 |
| Full/half | Antarctic | Southern bottlenose whale | 44 | 183 |
| Full/half | Antarctic | Sperm whale | 21 | 119 |
| Full/half | Antarctic | Weddell seal | 18 | 124 |
| Quarter | Antarctic | Antarctic minke whale | 224 | 6136 |
| Quarter | Antarctic | Arnoux beaked whale | 275 | 297 |
| Quarter | Antarctic | Blue whale | 12 | 325 |
| Quarter | Antarctic | Crabeater seal | 1962 | 9865 |
| Quarter | Antarctic | Humpback whale | 59 | 1605 |
| Quarter | Antarctic | Killer whale | 169 | 472 |
| Quarter | Antarctic | Leopard seal | 117 | 598 |
| Quarter | Antarctic | Minke whale | 237 | 6389 |
| Quarter | Antarctic | Ross seal | 75 | 365 |
| Quarter | Antarctic | Sei whale | 8 | 221 |
| Quarter | Antarctic | Southern bottlenose whale | 243 | 272 |
| Quarter | Antarctic | Sperm whale | 80 | 230 |
| Quarter | Antarctic | Weddell seal | 90 | 447 |